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Petroleum Refiner

JANUARY
1957

SPECIAL MAINTENANCE REPORT

BE SAFE AND APPEALING

More Color in Plant Will Pay Off

. . . p. 120

WATCH YOUR WAREHOUSE

Keep Inventory Down, Profits Up

. . . p. 139

REDUCE COSTS

Water Can Ease Turbine Cleaning

. . . p. 150

COMPARE YOUR EXPENSES

Survey Reveals Trends in Costs

. . . p. 174

IMPROVE BUILDER RELATIONS

Incentive Contracts Can Save Money

. . . p. 187

NEW SAFETY SERIES

How to Protect Plants From Fires

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For a "Quick Look" at this issue, turn the page . . .

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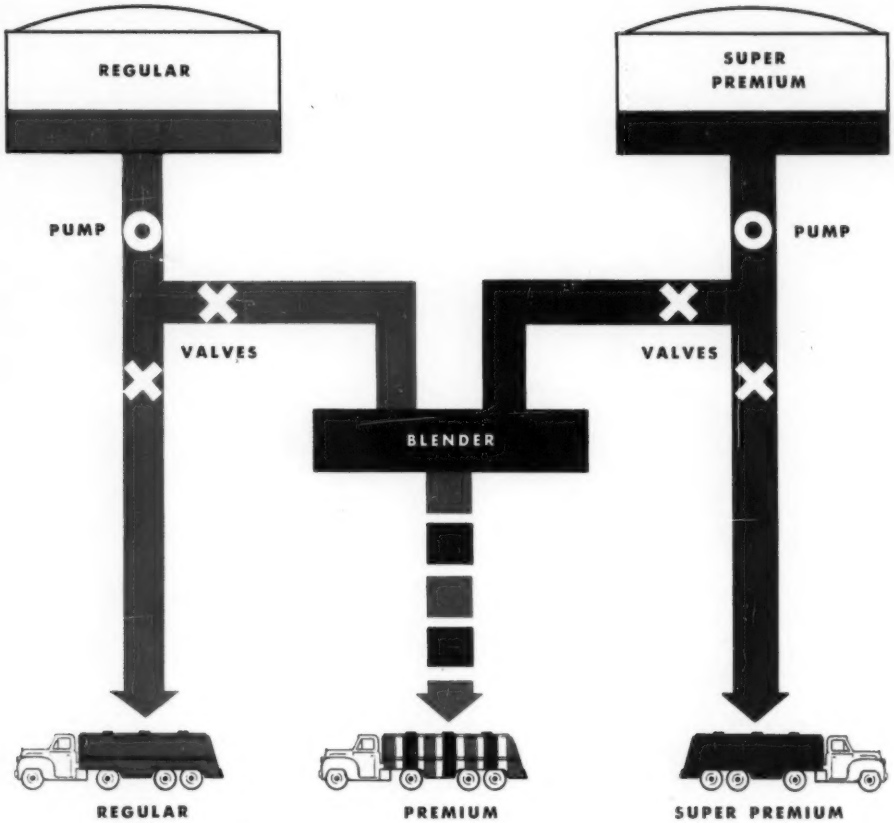

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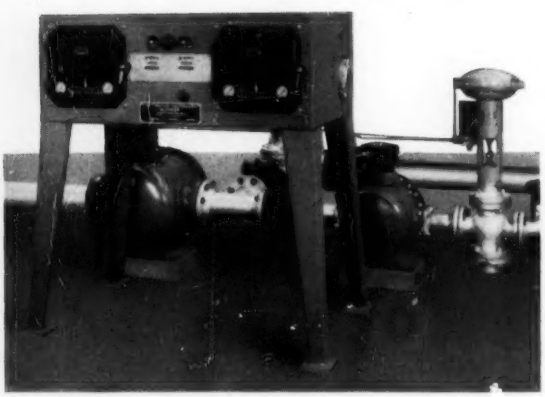

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Volume 36, No. 1 January, 1957

SPECIAL MAINTENANCE REPORT 117
Foreword 119
Frank L. Evans, Jr.
Color Can Revolutionize Your Plant 120
R. H. Bacon and V. B. Volkening
New Ways to Reduce Painting Costs 125
M. L. Monack, H. W. Shockley and J. R. Allen
How to Organize Your Painting Program 129
Lew T. Gray
Maintenance Must Be Planned 132
Ernest W. Fair
Does Inspection Increase Maintenance Costs? . . 133
J. O. Thoen
Maintenance Must Grow With Your Plant 135
E. W. Jones & J. C. Shouse
Are You Caught With Your Stock Up? 139
Joe W. Cook
How Esso's Mechanical Department Works 143
Keep Inspection Records the Easy Way 147
J. P. Chamberlain
Use Water to Clean Your Steam Turbines 150
M. M. Mitchelson
An Ounce of Preventive Maintenance 151
E. R. Franklin
How to Select and Maintain Expansion Joints . . 155
K. S. Roberts
How to Maintain Steam Traps? 161
Leo Walter
Centrifugal Pump Packings and Seals (Part 1) . 163
Harold Woodhouse
V-Belt Maintenance 167
W. S. Worley
Integrate Your Major Revamps With a Turnaround 169
E. H. Boullioun, Jr.
Ways to Improve Instrument Maintenance 171
Paul Taylor
Maintenance Costs Drop 174
New Ideas in Preventive Maintenance 175
C. F. Canney

OTHER TECHNICAL FEATURES

A New Look at Paraffin Waxes 180
R. T. Edwards
Incentive Contracts Do Save Money! 187
J. E. Ross
Graph Makes Anchor Bolt Analysis Easy 189
Andrew A. Brown
Here Are Ammonia Plant Design Tips 193
C. E. Freese
Taking Stock 198
Cecil W. Smith
Automation Today (Part 7) 199
Theodore J. Williams

As Management Sees It . . .

How Oil Acts When It Burns (Part 1) 114
J. L. Risinger
Make Your Ideas Pay 264
Charles H. Clark

DEPARTMENTS

LOOK BOX, Featuring . . .
"A Calm Look at Chaos" 109
Quick Look 3
Mail Box 100
Quick Look at Industry . . 105
If Oil Could Speak 106
Valuable Reading Ahead . 202
Reviewing New Books . . . 204
How To Do It 207
Who's Building 215
Construction Boxscore . . . 233
What's Happening 274
Meeting Calendar 293
Men In Industry 294
Suppliers Notes 304
Classified Advertising . . . 334
New Equipment 338
Manufacturers Literature . 338
Index to Advertisers 354
Readers' Service Card . . . 355

PETROLEUM
REFINER
REFINING | PETROCHEMICALS | NATURAL GASOLINE

A Quick Look

at This Maintenance Issue

These handy digests permit checking those articles you want to read first.

SPECIAL MAINTENANCE REPORT

☐ **Color Can Revolutionize Your Plant . . .** Does your plant look slightly drab and colorless? Here's a way you can use "mass color" in your plant to increase safety, pride and morale. For complete details, turn to **Page 120.**

☐ **New Ways to Reduce Painting Costs . . .** Three requirements of a successful painting job are proper surface preparation, coating selection and application. By meeting these requirements you can at least double the life of most protective coatings, and thus reduce maintenance painting costs appreciably. For a plan that will enable you to cut the first cost of a coating job 10 to 30 percent, turn to **Page 125.**

☐ **How to Organize Your Painting Program . . .** Two key figures are the protective coating engineer and the paint foreman. Here's how they can improve your painting program. For complete details, turn to **Page 129.**

☐ **Does Inspection Increase Maintenance Costs? . . .** This perennial question has aroused countless opinions, but never a definite answer. Here is a definite answer . . . by a top expert in the field . . . an answer that may help you cut maintenance costs. Turn to **Page 133.**

☐ **Maintenance Must Grow With Your Plant . . .** Here's how one plant combined the good points of a "zone" and a "centralized" maintenance system, and reduced labor costs while the plant continued to grow. Turn to **Page 135.**

☐ **Are You Caught With Your Stock Up? . . .** Heres' a way to reduce costs and increase profits through inventory control and warehouse stock reductions. Turn to **Page 139.**

☐ **How Esso's Mechanical Department Works . . .** Here is how one refinery reorganized and made a smooth transition from the "craft" to the "field supervision" system. Turn to **Page 143.**

Please Turn Page ➔

A Quick Look at This Issue . . .

☐ **Keep Inspection Records the Easy Way . . .** Having trouble keeping inspection records? Here's how a small refinery solved its problem with a modern record keeping system. Turn to **Page 147.**

☐ **Use Water to Clean Your Steam Turbines . . .** Would you like to reduce the sandblasting and hand scraping required to clean steam turbines? Here's how one company uses water to clean its turbines, thus saving many hours of maintenance time. Turn to **Page 150.**

☐ **An Ounce of Preventive Maintenance . . .** Proportioning pumps must receive care in installation, and a preventive maintenance routine must be established, or the precision of this diminutive pump may be in jeopardy. For complete details, turn to **Page 151.**

☐ **How to Select and Maintain Expansion Joints . . .** If you are confused about all the types of expansion joints, here's a method of selecting and maintaining the right one for the job. Turn to **Page 155.**

☐ **How to Maintain Steam Traps . . .** Simplify the problem by working out a definite plan of inspection through regular rotation of traps. For a detailed plan on steam trap maintenance, turn to **Page 161.**

☐ **Centrifugal Pump Packings & Seals . . .** The first article in this series deals with centrifugal pump packing boxes and glands. It tells how they function, what can go wrong and how to maintain them. Turn to **Page 163.**

☐ **V-Belt Maintenance . . .** Although V-belt drives characteristically require little care, knowledge of a few basic installation and maintenance procedures can increase service life and efficiency considerably. To see how these common sense rules compare with practices in your own plant, turn to **Page 167.**

☐ **Integrate Your Major Revamps With a Turnaround . . .** Here's a way to increase cat cracker capacity 50 percent in conjunction with its turnaround. For complete details, turn to **Page 169.**

☐ **Ways to Improve Instrument Maintenance . . .** Increased automation requires tremendous improvements in the instrumentation field. Your instrument maintenance program must keep up and here's a way to do it. Turn to **Page 171.**

☐ **Maintenance Costs Drop . . .** These results of an industry-wide cost survey show you for the first time what is being spent for maintenance as a percentage of replacement value. See how your operation compares with these averages and trends. Turn to **Page 174.**

☐ **New Ideas in Preventive Maintenance . . .** These ideas show how you can have fewer production delays . . . less costly repairs, and at the same time produce greater throughput and greater profit. For complete details, turn to **Page 175.**

☐ **A New Look at Paraffin Waxes . . .** Their specifications are getting more rigid so it's time to take another look at how composition affects wax properties. In this article, you'll find how important the non-normal hydrocarbons are in determining these properties. Turn to **Page 180.**

☐ **Incentive Contracts Do Save Money . . .** Here are eight policies and four general steps to insure good contractor-owner relations. This form of incentive bidding insures good control of construction costs and better results from your construction dollar. These axioms can save you money. Turn to **Page 187.**

☐ **Graph Makes Anchor Bolt Analysis Easy . . .** The usual method for designing anchor bolts on tall, cylindrical towers is not adequate if the towers are eccentrically loaded. High wind loads or earthquakes can cause failures which may be disastrous. You can be sure if you follow the method that starts on **Page 189.**

☐ **Here Are Ammonia Plant Design Tips . . .** There are no well defined paths to follow in this extremely high pressure field. Nine important points to consider in the mechanical design of vessels, tubing, flange connections, compressors, valves, and liquid-air plants are discussed. Study this experience report before you design. Turn to **Page 193.**

☐ **Automation Today (Part 7) . . .** Here is a continuation of the series of articles on automatic control. This part discusses sampling and points up some of the types and sources of inaccuracies which may exist for sampling components of the control loop. Keep up with the developments in automation by turning to **Page 199.**

☐ **How Oil Acts When It Burns (Part 1 of a Series) . . .** This month PETROLEUM REFINER is beginning a series of articles that promises to fill a long standing need in the refining industry. Starting with the basic fundamentals (definitions and crude characteristics), one of the nation's top authorities in fire fighting and fire prevention will cover every aspect of this vitally important field. Future articles will include new methods of preventing fires, new methods of extinguishment and control, safe handling and storage of jet fuels, safe storage of high vapor pressure products, effective safety and fire prevention programs, to name a few. Clip this series, it will make an excellent fire protection manual for any refinery. Turn to **Page 114.**

☐ **Make Your Ideas Pay . . .** You don't have to be an Einstein to think creatively. You only have to apply a few simple psychological laws. For a thought-provoking discussion of the four basic steps to creative thinking, plus a plan designed to help you make profitable use of brainstorming sessions, turn to **Page 264.**

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Johnny-on-the-Spot

PETROLEUM REFINER in this issue, commencing on Page 117, is presenting its annual Maintenance Section. In fact, we call this our "Maintenance Issue," incidentally our fourth such special since 1954. This doesn't mean that prior to 1954 we considered maintenance "a poor relation of processing operations." Heaven forbid! Since 1945 we have covered maintenance regularly. Our "How to Do It" department in those days was labeled "Maintenance." Since February, 1951 when for a spell we gave such discussions a "Maintenance and Operation" tag, we have averaged publishing two maintenance articles per issue. So PR is no Johnny-Come-Lately in the matter of maintenance emphasis. For many years we have recognized that maintenance is *the biggest single dollar consumer in processing plants* and we've treated it as such. That's the reason experienced maintenance men in growing numbers place their confidence in PR pages, the reason that men seeking the best information regarding maintenance practices are in most cases regular REFINER readers.

For Our Authors' Eyes

THE AUTHORS whose work you read from month to month in PETROLEUM REFINER aren't exactly neglected. But too often they are taken for granted, these men who pour into one small vial, a two or three-page article, the results of years of study and research and experience. There's nothing that cheers an editor's heart more than a sound, well developed manuscript on a timely topic. So at a New Year's beginning we want to whoop a big "thank you" in their direction and hope that 1957 and years to follow will be happy, productive ones for them all.

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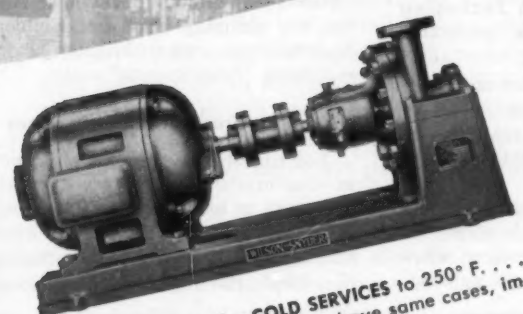

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- They have extra large impeller eye areas at minimum height centerline for lowest NPSH requirements and special volute design for smooth running over complete capacity range.
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2. Heavy weight jacketing designed for lines subject to abuse.
3. Deep Corrugated Jacketing with factory-attached moisture barrier for towers, vessels and tanks.
4. New resin adhesive that makes a stronger bond between the jacketing and the vapor barrier.

Childers Aluminum Jacketing provides strong, durable protection with three way savings:

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2. Lower application cost because it's so easy to cut-to-size and attach.
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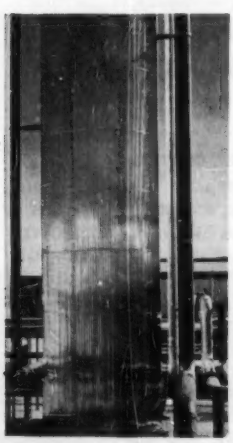
Send for Free Sample and Prices

You can help increase the efficiency of your insulated lines, towers, vessels and tanks by using Childers Jacketing. Write today for free sample and engineering data. Childers Manufacturing Co., Dept. PR-37, Houston 8, Texas.



New Deep Corrugated Jacketing For Towers, Vessels and Tanks

Only Childers offers deep corrugated aluminum jacketing with factory-attached moisture barrier. Available in 1¼" and 2½" corrugations. Childers Deep Corrugated Jacketing is used to provide permanent protection for insulated towers, vessels and tanks.

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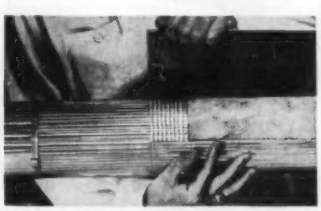

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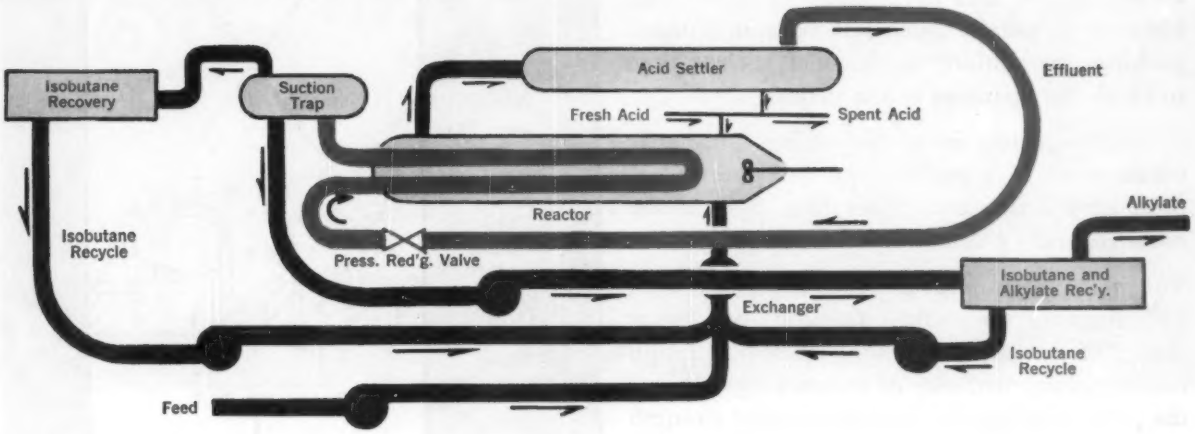

H_2SO_4 consumption – as low as 0.3 lb per gal of alkylate

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Conventional flat ceramic support plates have an actual free area of 20-30%. *Effective area,* however, is usually much less, because dumped packings, particularly in the smaller sizes, tend to block the openings in the plates.

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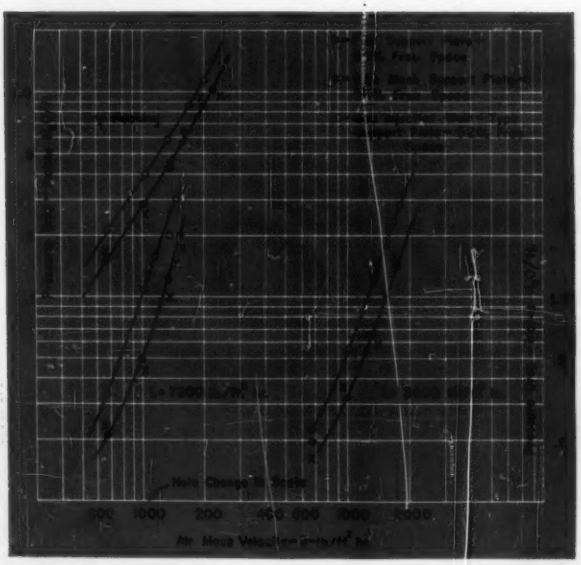
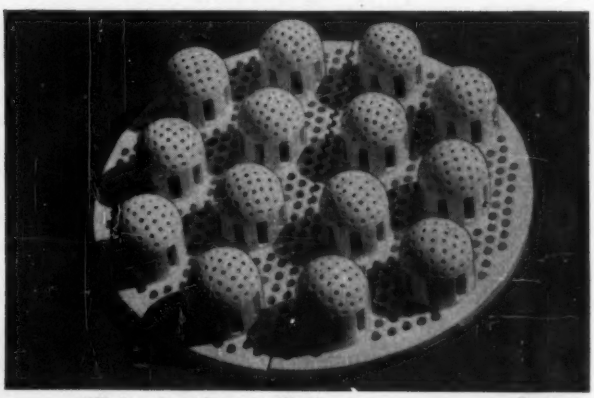
In operation, the gas is actually injected or distributed into the column through the perforated hemispherical caps and through the upper portion of the slots in the risers. A major portion of the liquid ordinarily leaves the column through the openings in the base plate, but should these openings prove insufficient, and a slight head form, the overflow will escape through the bottom half of the slots in the risers.





Write for New Bulletin — on Weir-Type Support Plates

*U. S. Stoneware patent pending

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NEW YORK **CHICAGO** **HOUSTON**

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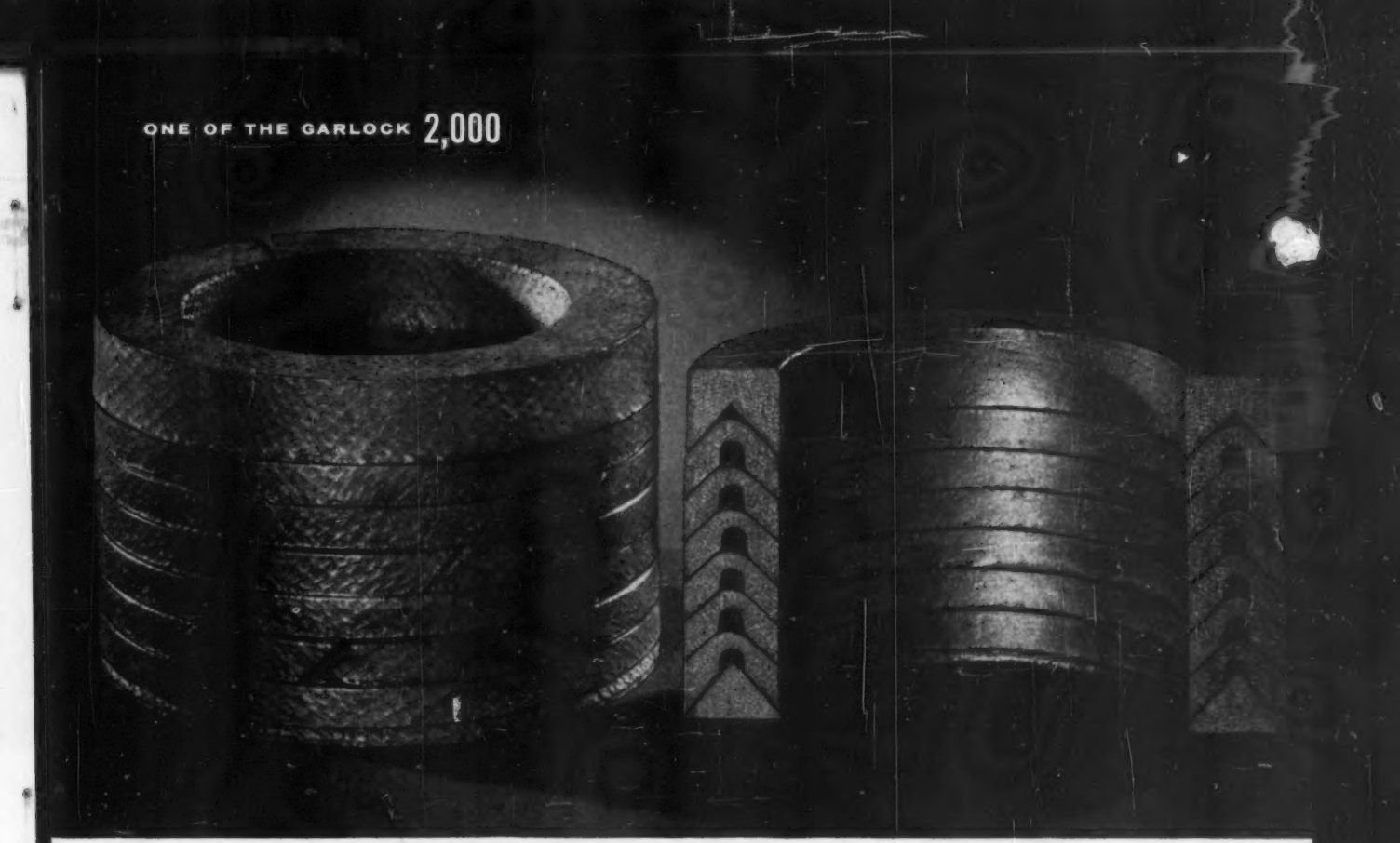
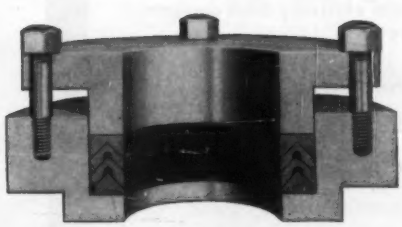


Why Garlock CHEVRON* Packing is really Automatic



This design is entirely different from ordinary V-type packings. CHEVRON has an exclusive hinge-like construction, assuring the automatic action for which it is designed. This also permits the use of less packing in shallower stuffing boxes.

The unique construction of Garlock CHEVRON permits free operation of rods or plungers at all pressures. As pressures increase the packing automatically tightens to prevent leakages. As pressures decline the CHEVRON Rings instantly ease off permitting free operation without leakage.

Therefore, after you make initial adjustment of the gland, no further adjustments are needed to compensate for variations in pressures.

Exclusive CHEVRON is one more part of "the famous Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every need—the only complete line. That is why you get *unbiased* recommendations from your Garlock representative. Call him today or write for CHEVRON Folder AD-115.

*Registered trade-mark

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

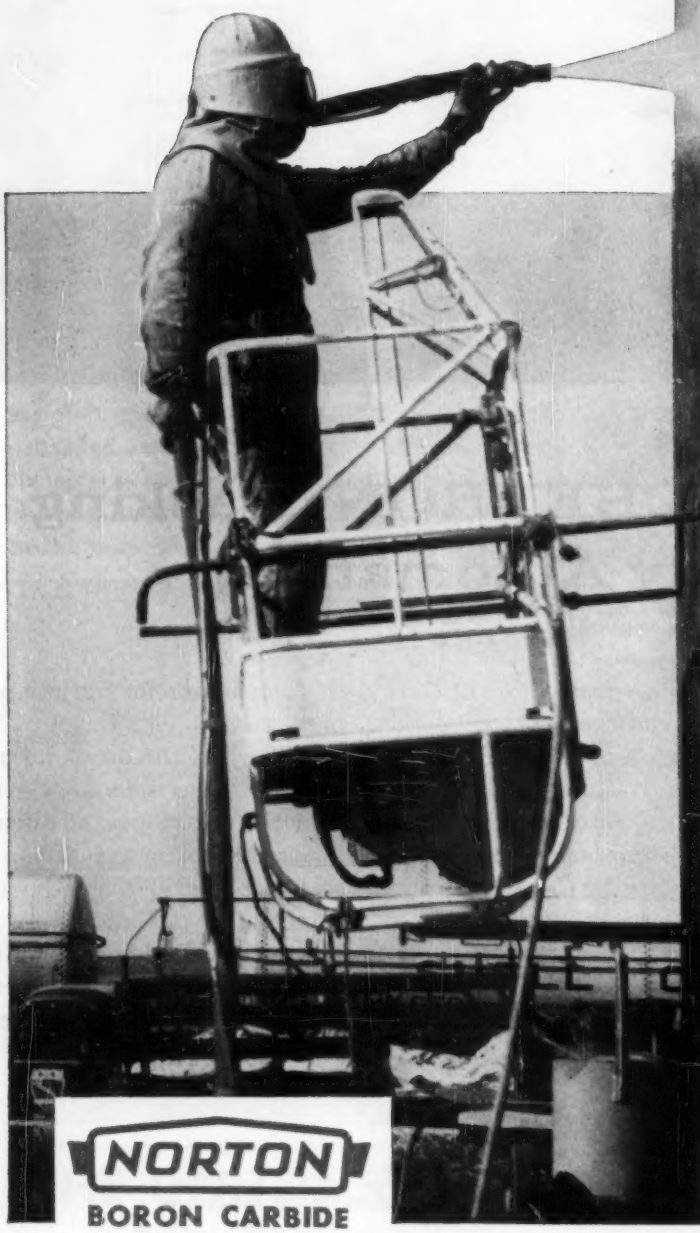
Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints

For

EFFICIENT BLAST CLEANING at MINIMUM COST

Specify

NORBIDE® Pressure Blast Nozzles



If you are descaling large areas like this storage tank, or cleaning small areas, you'll get maximum blast cleaning efficiency at minimum cost when you use NORBIDE Pressure Blast Nozzles.

These nozzles — lined with the hardest material made by man — are available with bores ranging from ⅛" to ⅞", with either flanged or threaded fittings. They are guaranteed for 1500 hours with steel shot or grit, or 750 hours with silica sand before the outlet enlarges more than one-half its original size.

This amazingly slow rate of wear helps conserve compressed air, reduces cleaning time and provides maximum efficiency from equipment and crew.

For full details on cost-cutting NORBIDE® Nozzles, write for your free copy of Form 543.

NORTON COMPANY
460 New Bond Street
WORCESTER 6, MASS.

NORTON
BORON CARBIDE

NORBIDE®. . . *The Longest Nozzle Life You Can Buy*

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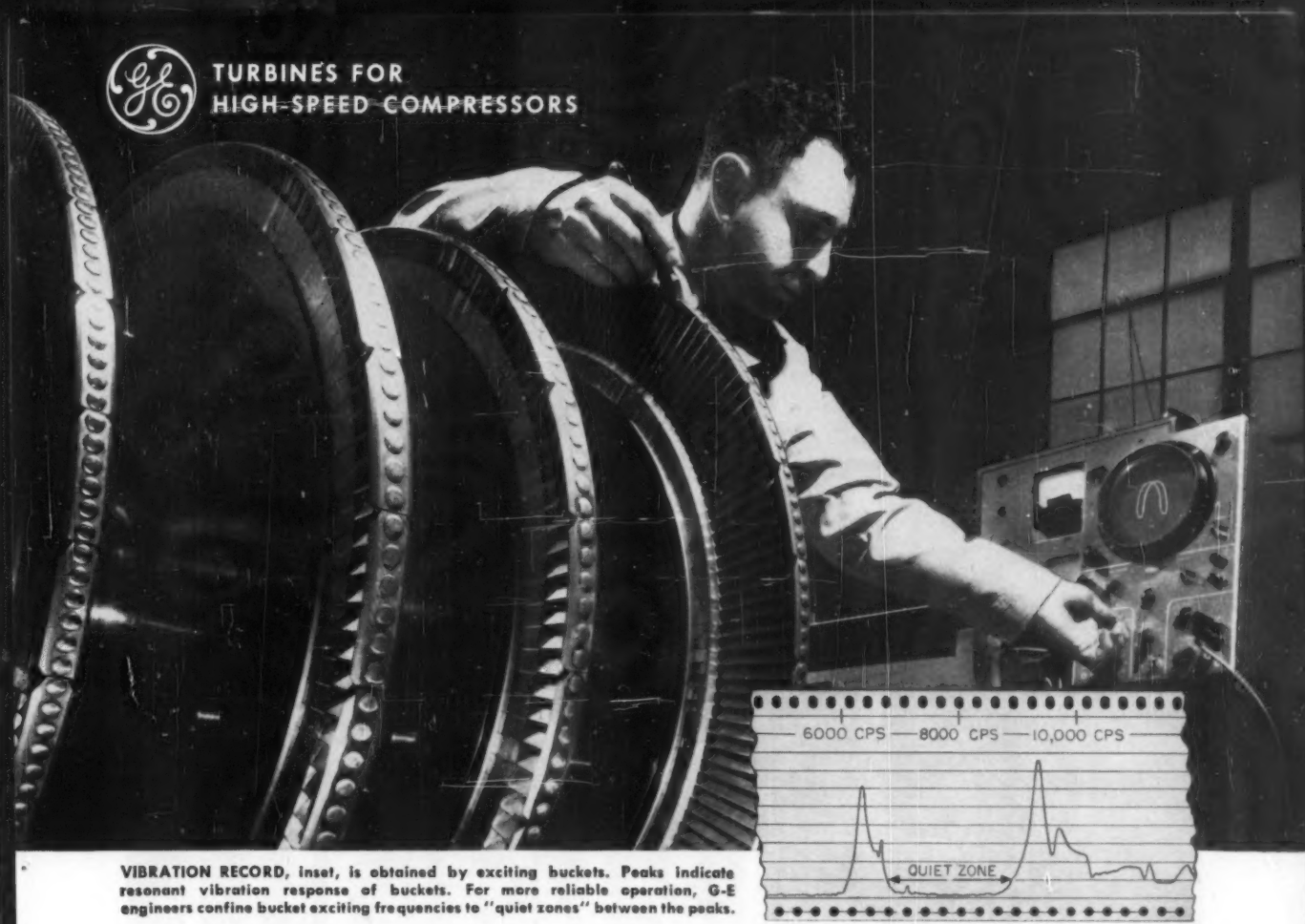
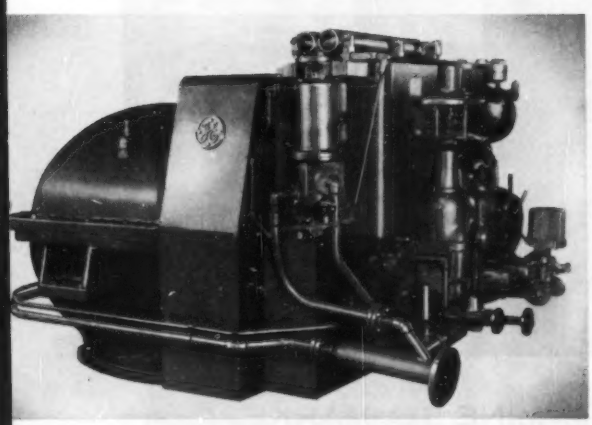
TURBINES FOR
HIGH-SPEED COMPRESSORS



VIBRATION RECORD, inset, is obtained by exciting buckets. Peaks indicate resonant vibration response of buckets. For more reliable operation, G-E engineers confine bucket exciting frequencies to "quiet zones" between the peaks.

How General Electric Engineers Locate "Quiet Zones" for Safer High-speed Turbine Operation



TYPE DRV HIGH-SPEED MECHANICAL-DRIVE TURBINE

* In Canada, contact Canadian General Electric
107 Park St., Peterborough, Ontario

When driving modern compressors and blowers, G-E high-speed turbines spin at operating speeds of 7000 rpm and up. At such speeds, if resonant vibration were not controlled carefully, bucket fatigue failure might result.

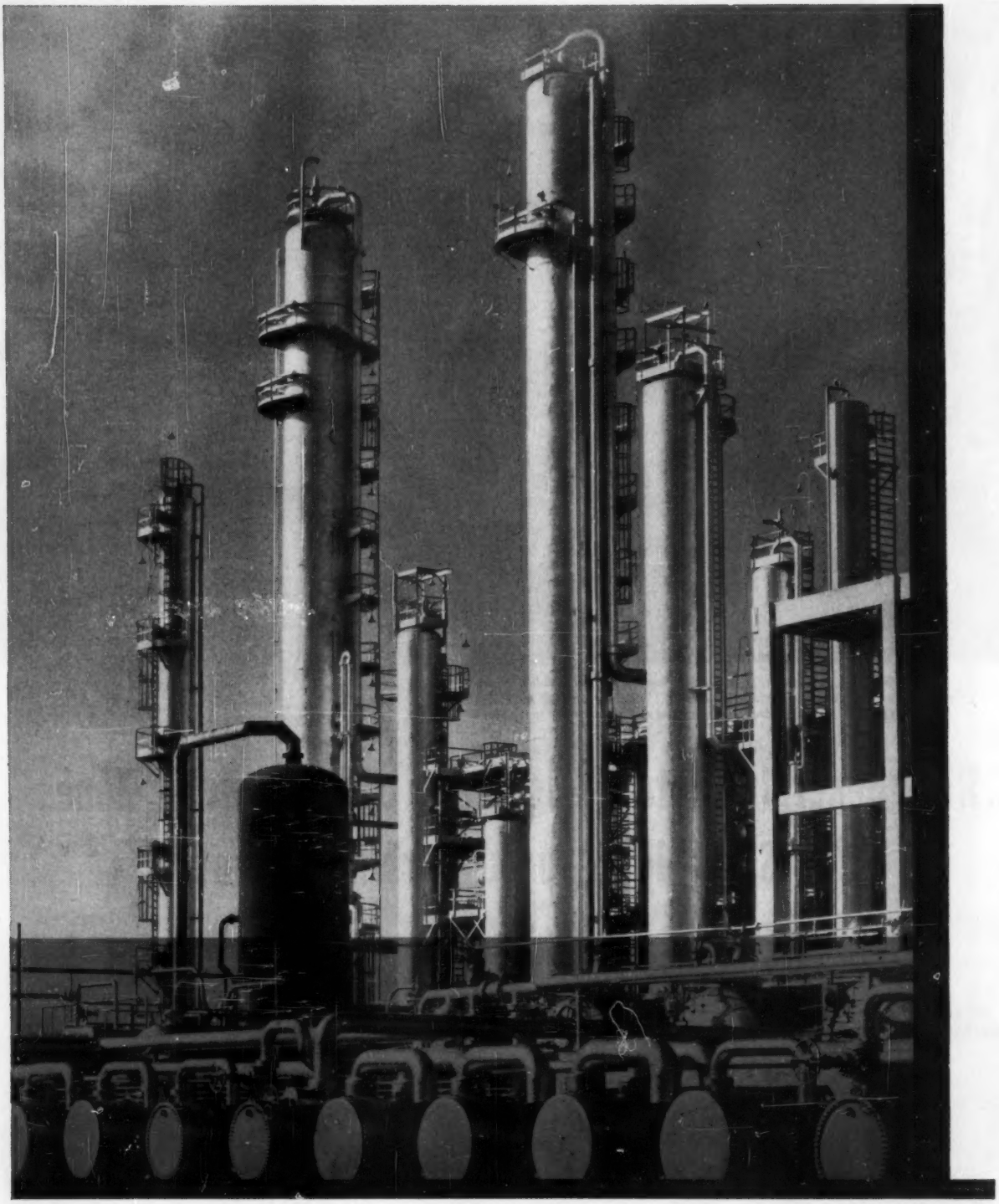
HERE'S HOW General Electric combats the problem: Natural vibration frequencies of the buckets on each new turbine rotor are determined with the special equipment shown above—an oscillator, crystal pick-up, and high-speed level recorder. "Quiet zones" of minimum normal vibration are clearly revealed.

With this information available, the number of nozzles can be varied so that steam striking the buckets will create vibration-exciting frequencies only in these "quiet zones." By thus making sure that steam-impact frequencies don't coincide with critical natural frequencies, the chance of bucket failure is greatly reduced.

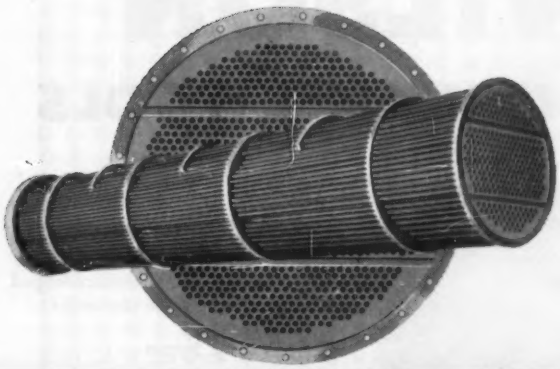
VIBRATION TESTING is one of many features adding to G-E high-speed turbine reliability. For more information, contact your G-E Apparatus Sales Office* or write for bulletin GEA-6232, Section 241-2, General Electric Company, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!



For dependable "on-stream" performance...
retube your exchangers with

PHELPS DODGE HEAT EXCHANGER TUBES!

Wide selection of copper-base alloys for every type of application—including bi-metal combinations.

Complete warehouse stocks maintained at Houston, Texas; Tulsa, Okla.; Los Angeles, Cal.; Chicago, Ill.; and Bayway, N. J.

Expert assistance in solving your tube corrosion problems.

Specify Phelps Dodge... One of the largest suppliers of tubes to manufacturers of heat exchangers!

PHELPS DODGE COPPER PRODUCTS CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

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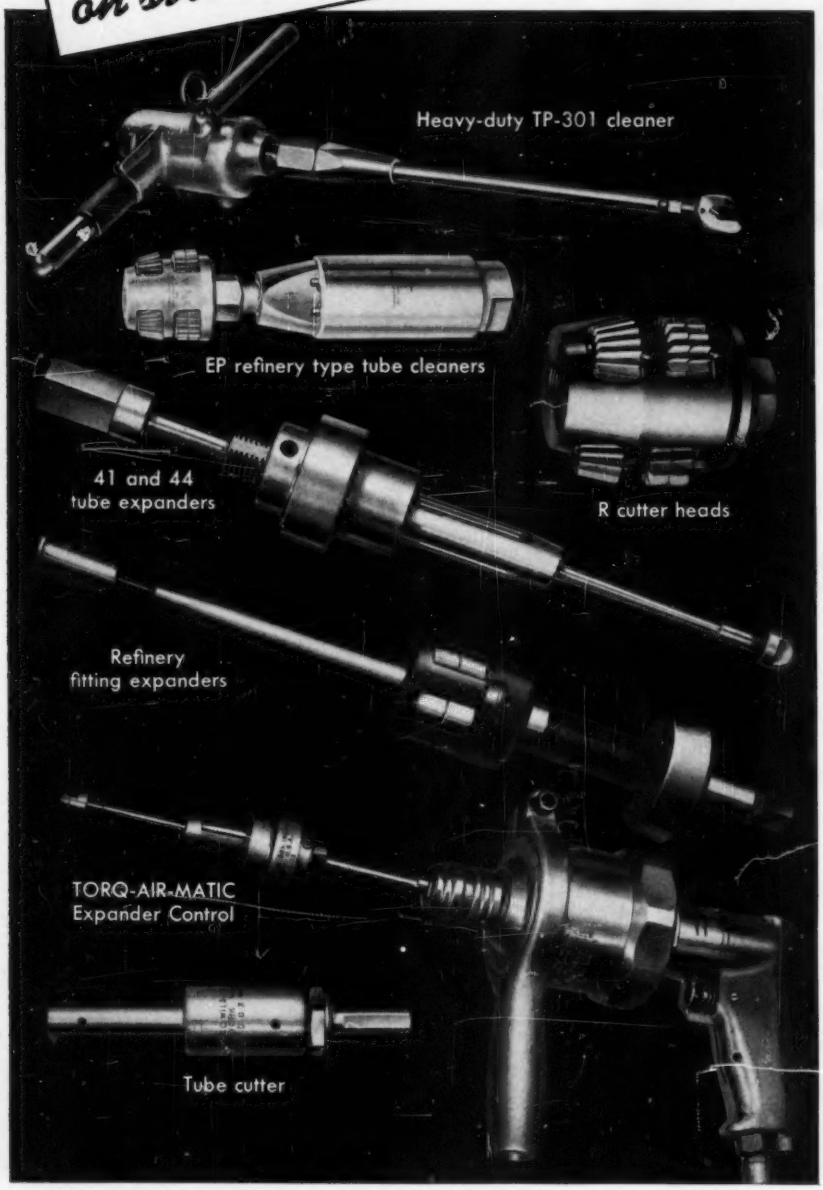
Keep tubular equipment on stream with...

WILSON
MAINTENANCE TOOLS



Heavy-duty TP-301 cleaner
Powerful air-driven, hollow rotary shaft, drill type tool. Tube is scavenged with air or water while cleaning.

EP refinery type tube cleaners
These heavy-duty "matched sets" are designed for rugged service in removal of heavy coke or scale deposits from still tubes, transfer lines, service pipe lines, etc.

R cutter heads
The Model R is a self-feeding, double expansion head, specifically designed to endure sustained abuse with the minimum of maintenance. Excellent for refinery still tubes.

41 and 44 tube expanders
Wilson Models 41 and 44 Tube Expanders incorporate an improved, adjustable ball bearing thrust collar and are designed for efficient, easy rolling and maximum roll length adjustment for various tube sheet thicknesses.

Refinery fitting expanders
Various heavy-duty expanders are available for all types and sizes of refinery fittings and tubes. Made of the best steel available for this purpose.

TORQ-AIR-MATIC Expander Control
The Wilson Torq-Air-Matic is the first and only air-driven tube expander drive that accurately controls tube expansion by directly measuring torque output at the mandrel.

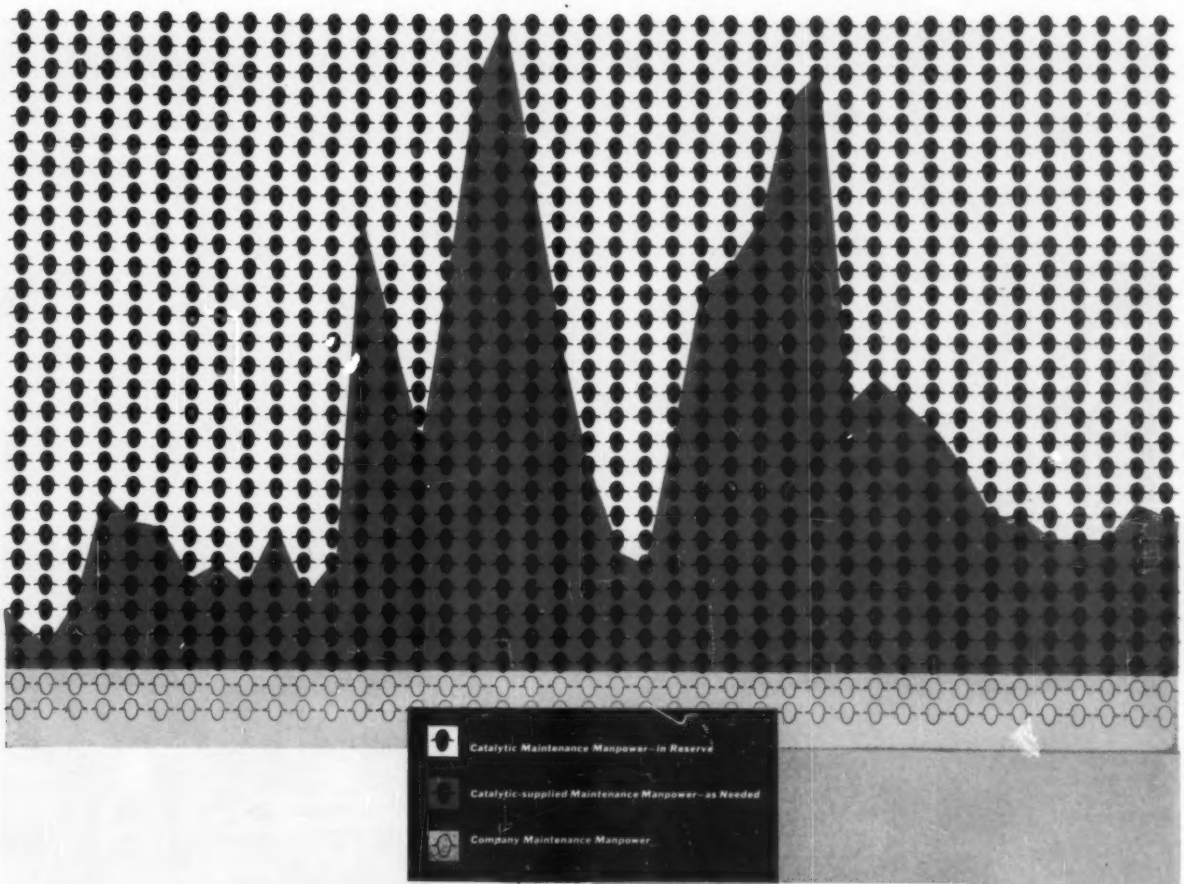
Tube cutter
Wilson tube cutter is easy to use and does a fast job. Just chuck it into existing drill. Cutter sizes available to meet all heat exchanger requirements.

Representatives in principal cities
THOMAS C. WILSON, INC. • 21-11 44th Ave., Long Island City 1, N. Y.
Cable address: "Tubeclean", New York

TW 873

WILSON
TUBE CLEANERS • TUBE EXPANDERS

Write today for your copies of Wilson Tube Cleaner catalog No. 77 and Wilson Tube Expander Catalog No. 88.



HOW HIGH ARE YOUR MAINTENANCE COSTS?

This graph of the actual maintenance manpower load of an operating refinery demonstrates the value of CATALYTIC's Contract Maintenance Service.

CATALYTIC BALANCED MAINTENANCE

1 Eliminates high labor turnover, idle crews, overtime costs.

2 Saves time and dollars in emergencies.

3 Offers highly productive, skilled workers.

4 Adapts itself flexibly to your maintenance problems.

5 Reduces investment in expendable hand tools and equipment.

Investigate the advantages of this plan to your operation—with an eye to higher productivity and lower maintenance costs.

CATALYTIC • ENGINEERS • CONSTRUCTORS

CATALYTIC

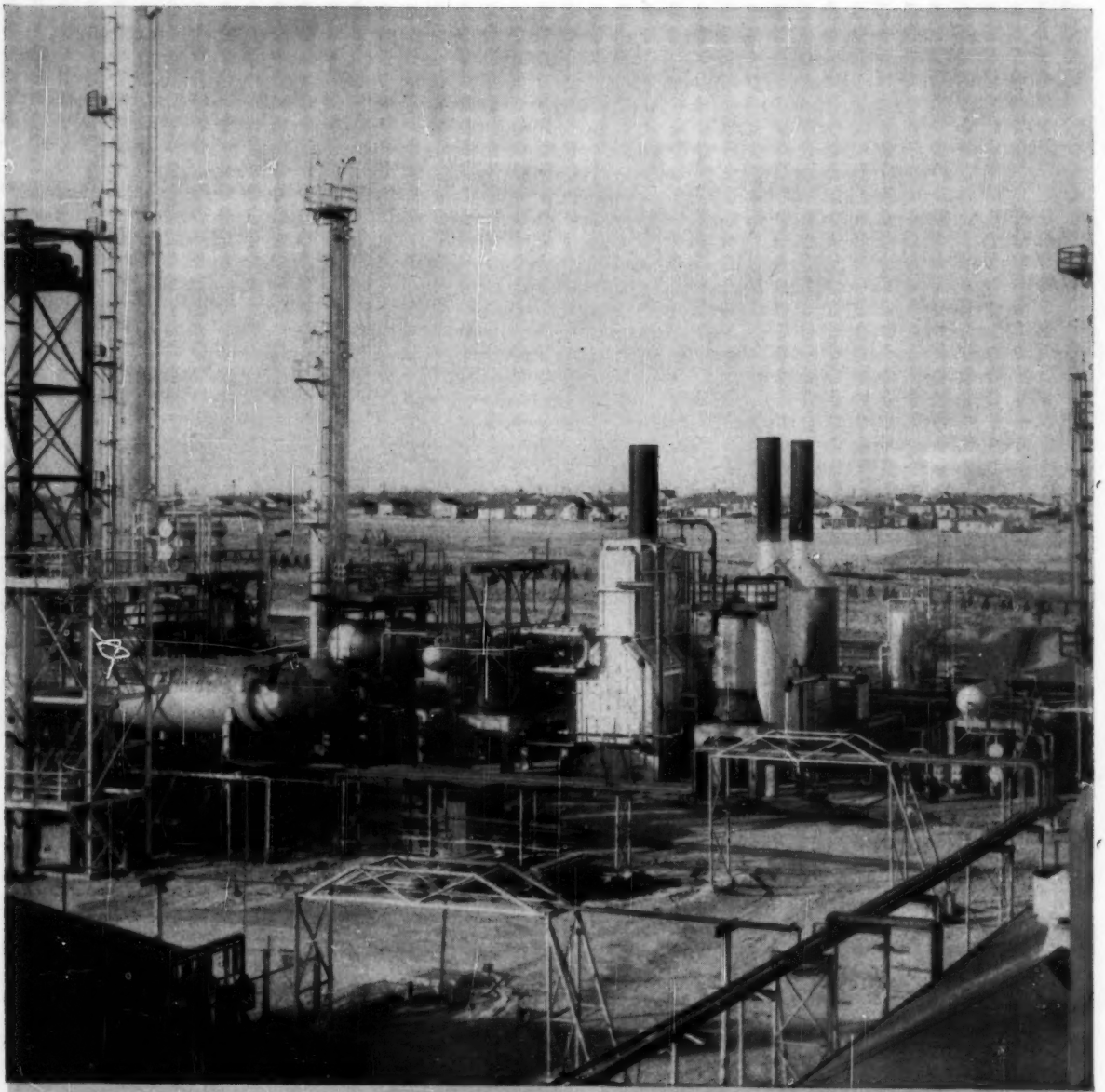
CONSTRUCTION COMPANY

Philadelphia 2, Pennsylvania. Toledo, Ohio

In Canada Catalytic Construction of Canada, Limited; Sarnia, Ontario; Toronto, Ontario; Montreal, Quebec

CATALYTIC ON-TIME . . . ON-BUDGET SERVICES for the atomic energy, chemical, petrochemical and oil refining industries • Project Analysis • Process Design • Economic Studies • Engineering • Procurement • Construction • Plant Operation

For more data on advertised products, use Readers' Service Cards, last page.



Overall view of the UOP Platforming-Unifining units at the Cheyenne (Wyo.) refinery of Frontier Refining Company.

Unifining unit reactor, with reactor charge heater in background.

Frontier engineer adjusts fuel gas control valve on Platformer charge heater.

Unifining Cat Cycle Oil Solves Major Sales Problem For Frontier

By M. H. Robineau
President
Frontier Refining Company
Denver, Colo.

A year of steady progress has been experienced by our company since the installation of two new refinery processing units—a UOP Platformer and a Unifining unit.

M. H. Robineau

Before these processes were added, Frontier had a serious sales problem due to the high sulfur content of our cat cycle oil which made it difficult to market profitably our entire daily production of 1,600 barrels of this distillate. We had two markets for this material—Diesel fuel for the Union Pacific Railroad and No. 2 domestic burner oil.

Since the cat cycle oil as such had a sulfur content of 1.25 weight per cent, it failed in its original state to meet the railroad's specifications. Hence we were forced to blend it in equal proportions with a straight run Diesel fuel—for which we had a ready truck market—in order to produce a fuel which met the UP's standards. This operation was economically undesirable because the straight run Diesel which could have been sold for 11 cents a gallon as truck fuel, had to be blended with cycle oil to make a product acceptable to the railroad and for which we received approximately 9 cents a gallon. Compounding the problem was the fact that after selling the maximum possible quantities to the railroad, truck lines and home heating markets, we had remaining several thousand barrels a month of cycle oil which were sold at sacrifice prices as industrial oils because of the high sulfur content.

Another facet of the problem was a short supply of straight run Diesel oil, and there appeared to be little chance that additional amounts could be obtained from the two crude topping units, whose combined daily capacity approximated 10,000 barrels.

Frontier sought the help of Universal Oil Products Company to improve its distillate stock position. UOP, after extensive engineering and pilot plant studies, recommended that we install a Unifining unit to operate alternately on a charge of either 3,000 B/SD of straight run distillate or 2,500 B/SD of a 50-50 blend of cat cycle oil with straight run distillate.

Frontier "bought the idea." However, a major obstacle had to be overcome—a practical source of hydrogen. It was decided to add Platforming not only because it would provide an economical source of hydrogen but because it would also substantially improve the overall octane rating of the refinery's gasoline and would effect considerable savings in the quantities of tetraethyl lead used for motor fuel blending purposes.

The contract for constructing the units was awarded to Procon Incorporated, and work was completed on schedule. With the aid of electronic instrumentation (Frontier is the first U. S. refinery to have liquid level indications completely transmitted by electrical impulses to the graphic panel), the units were lined out in relatively short time. Operation of the Unifining unit differed from the original schemes from the beginning. Instead of running on one of the alternate operating plans, cat cycle oil was charged to the unit and it ran on this feed for approximately two months.

Unifining this oil brought notable results. More than 90 per cent of the sulfur was removed, the bromine number was sharply reduced, compatibility was improved, and the cetane number and Diesel index were increased so that more cat cycle oil could be blended off into a higher priced product. The net result was the elimination of a product which formerly was sold at sacrifice prices in favor of one which required no special blending to make it 100 per cent salable.

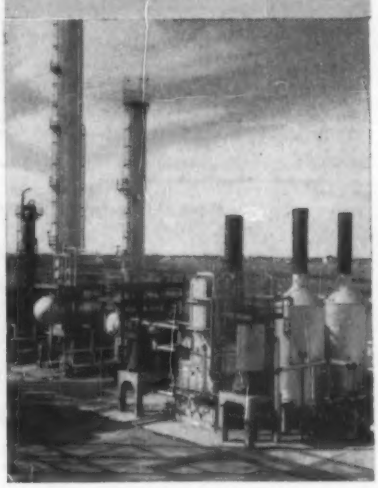
With the Platformer, Frontier has increased by three numbers the octane ratings of its gasolines while substantially reducing its requirements for tetraethyl lead. The ease of octane improvement inherent to Platforming has made it possible to use natural gasoline, previously employed to upgrade octanes, more profitably elsewhere in the refinery.

The successful operation of the Platforming and Unifining units has given Frontier a new impetus which has been reflected in a more economical refinery operation and a greatly expanded marketing program, the latter by virtue of our ability to offer to the public a variety of products much higher in quality than had been possible previously.

Frontier combines UOP Platforming and Unifining processes for increased operational economy and expanded marketing program

designed, engineered and licensed by
UNIVERSAL OIL PRODUCTS COMPANY
UOP
30 ALGONQUIN ROAD
DES PLAINES, ILL., U.S.A.

Forty Years Of Leadership
In Petroleum Refining Technology



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How to pick the 1 tubing steel out of 24 to give you longest tube life per dollar

Ask the experts!

OF THE 24 different high-temperature tube steels the Timken Company offers to solve your heat, pressure, corrosion and oxidation problems, *one* analysis is most exactly suited to your particular needs, to give you maximum tube life per dollar of cost.

To find this analysis, *ask the experts.*

These experts are the metallurgists of The Timken Roller Bearing Company. The benefit of their more than 20 years of steel research and experience—with emphasis on high-temperature steels—is yours for the asking. They'll help you select the analysis that will give you longest tube life for your money—the only true measure of actual tube steel cost.

Whichever analysis you choose, you can be confident of uniform quality. The Timken Company maintains rigid quality control from melt shop through final inspection.

Why not let the Timken Company's metallurgists help pick the tubing steel that can solve *your* problem? *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

This month's report is on:

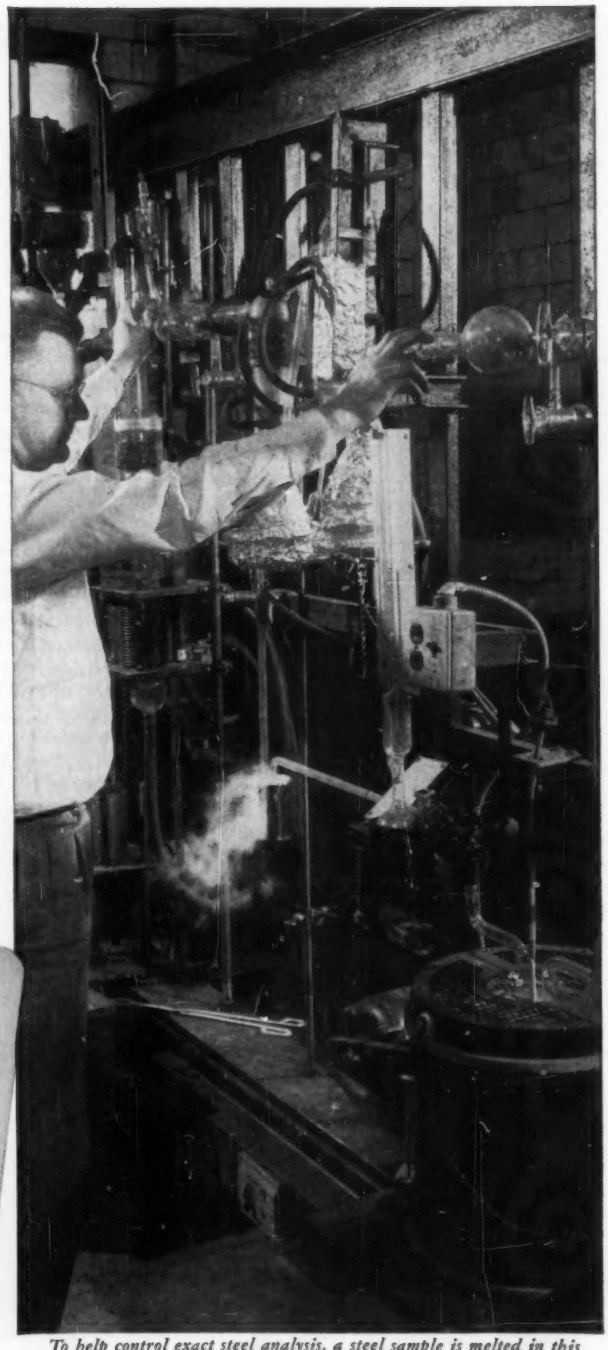
18-8 STAINLESS

An austenitic, non-magnetic alloy that shows the best combination of creep strength, oil corrosion resistance and oxidation resistance for service up to 1500°F. For use in oil cracking systems, hydrogenation equipment, high temperature oil and steam piping, superheater elements, heat exchangers.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

Carbon	Sicromo 2	Sicromo 5S	18-8Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti	18-8 Cb	16-25-6**

* *Available as seamless tubing on an experimental basis only.*
** *Not available as seamless tubing.*



To help control exact steel analysis, a steel sample is melted in this vacuum fusion apparatus. Then gases are pumped out, and the amount present in the steel is determined.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

CHOOSE FROM 3 APPROACHES TO HIGHER OCTANES

The new HOUDRY ISO-PLUS Process combines the catalytic HOUDRIFORMING Process with either aromatics separation or thermal reforming to transform run-of-the-refinery, low-octane naphthas into gasolines with octane ratings in excess of 100 F-1 clear.

This modification of HOUDRIFORMING—already extensively tested—gives the refiner a 3-way approach to higher octane production.

3 Variations of ISO-PLUS HOUDRIFORMING

1. & 2. ISO-PLUS Aromatics Extraction Combinations

Variations of the ISO-PLUS Process employing aromatics extraction have produced yields of 100-octane gasoline, F-1 clear, of up to 91 percent of naphtha charge.

3. ISO-PLUS Thermal Processing

With thermal reforming as the supplementary process, ISO-PLUS processing yields 80 percent to 90 percent of reformed gasoline, depending upon the desired octane rating of the final product. This ISO-PLUS variation is especially attractive to refiners with available thermal reforming equipment.

Find out how ISO-PLUS HOUDRIFORMING can help you get higher octanes; write: Houdry Process Corporation, 1528 Walnut Street, Philadelphia 2, Pennsylvania.

HOUDRY
PROCESS CORPORATION
Pioneer in Catalytic Processes

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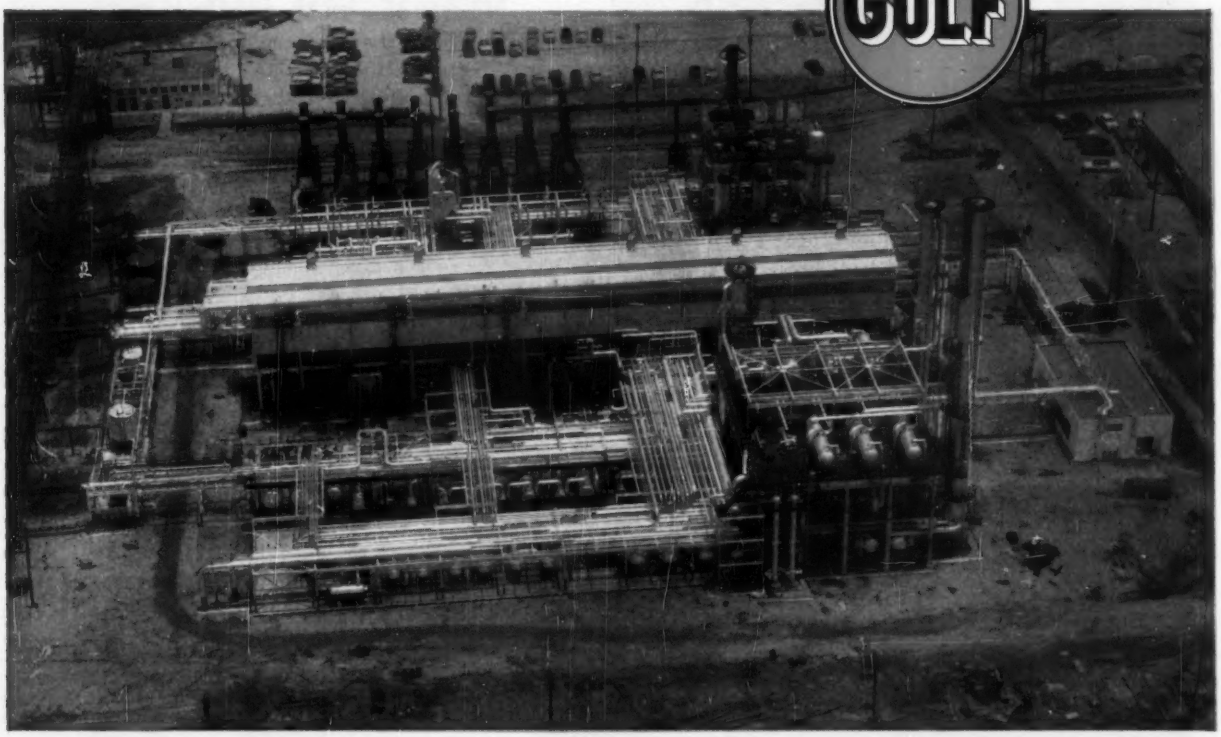
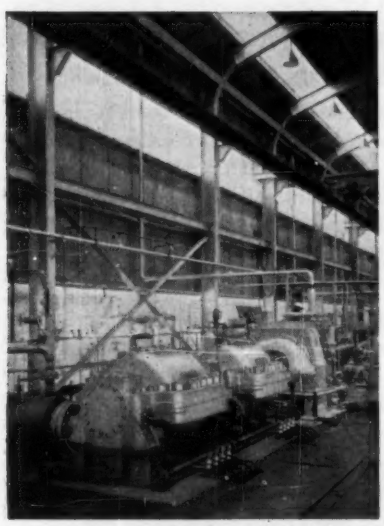
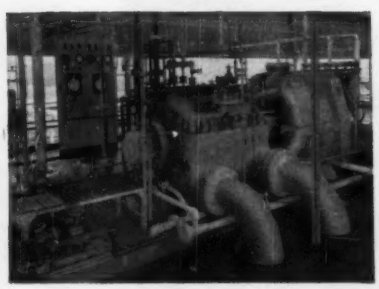
Six I-R turbo-compressors help increase capacity of

New ethylene plant of the Gulf Oil Corporation, Port Arthur, Texas. Stone & Webster Engineering Corporation, designers and constructors.

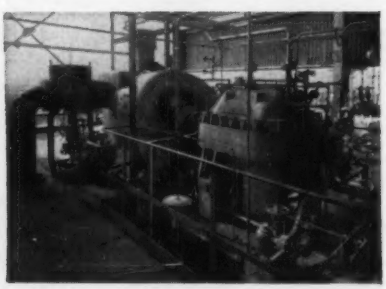




Steam-turbine driven I-R tandem centrifugal compressors in ethylene refrigeration service. Rated 3270 inlet cfm at 270 psia discharge pressure.



I-R gas compressor for handling feedstock. Rated 6230 inlet cfm at 252.7 psia discharge pressure. Driven by 4300 hp steam turbine.



I-R gas compressor, rated 11,400 inlet cfm at 264.7 psia discharge pressure. In propane refrigeration service. Steam-turbine driven.

AIR AND GAS COMPRESSORS for the process industries

Ingersoll-Rand builds a complete line of reciprocating and centrifugal compressors. Pressures range up to 35,000 psi and capacities up to 255,000 cfm. These machines are now serving in such important processing as synthesis of methanol, ammonia, rubber and toluol; hydrogenation and dehydrogenation; polymerization; and alkylation. Electric, steam, gas turbine, gas-engine, diesel and belt drive.

World's Largest Ethylene Plant

to over a million pounds a day!

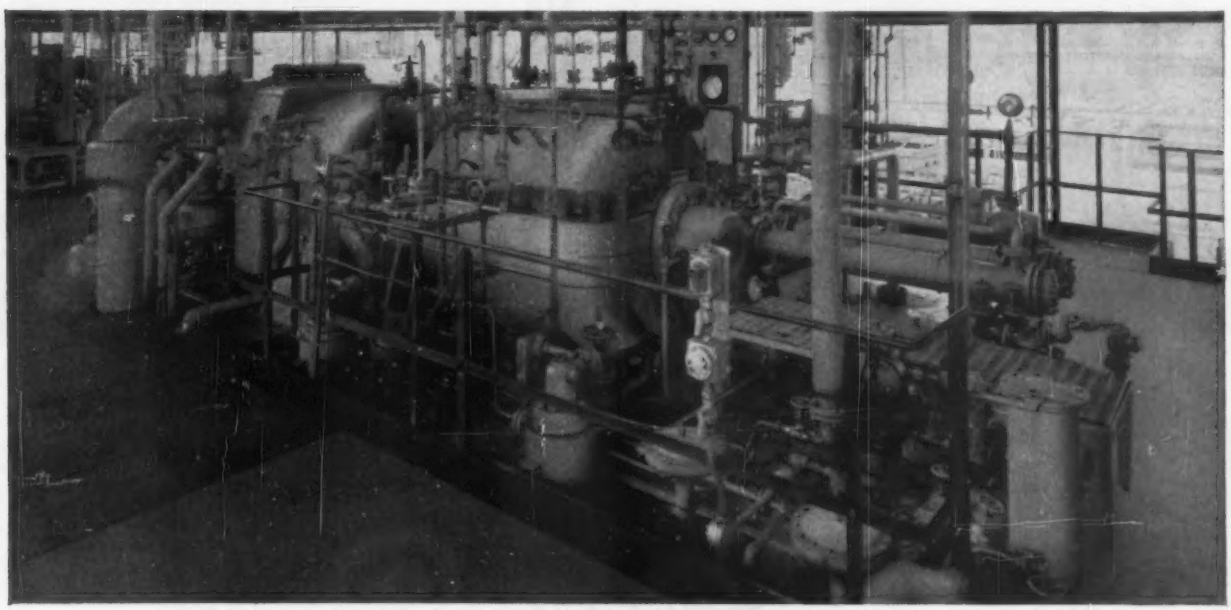
Serving Gulf Oil's Port Arthur No. 2 unit, these Ingersoll-Rand compressors are employed for compressing process gases and refrigerants

WHEN THE second ethylene unit of the Gulf Oil Corporation at Port Arthur, Texas, went on stream last year, it increased the plant's capacity by 220 million pounds a year. Now, the world's largest producer of commercial ethylene, it is supplying a growing number of customers in the Texas Gulf Coast area.

Of the six Ingersoll-Rand centrifugal compressors installed in the new No. 2 plant, three units are in process gas service. They are delivering a mixture of refinery gas and gas from the cracking furnaces to the recovery and separation section of the unit. The remaining three I-R compressors are handling ethylene and propane for cascade refrigeration in the separation section.

For exacting operations such as these, Ingersoll-Rand compressors have for years proven unusually successful. They meet the most rigid requirements of the process industries, in which millions of horsepower have now been installed.

Your I-R engineer will welcome the opportunity to help you solve your air or gas compression problems.

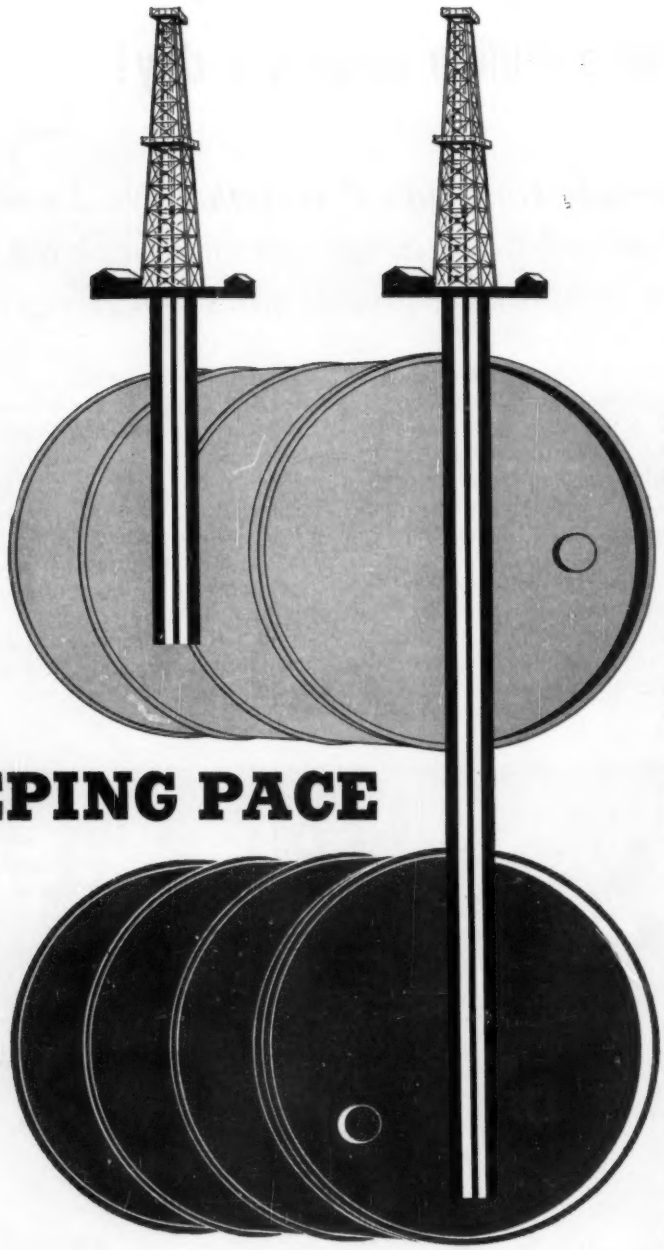


Close-up of I-R gas compressor. Steam-turbine driven, rated 19,100 inlet cfm at 76.2 psia discharge. For handling gases from cracking furnaces.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

12-456



KEEPING PACE

Drills were chewing their way down for about 2000 feet in the search for oil in 1916. Today's drilling depth is more than double that.

The change in drilling that forty years has brought well symbolizes many advances in the petroleum and chemical industries. Engineers have dug more deeply into the secrets of nature, too . . . have designed plants and processes to wrest new products and services from petroleum, ores and elements.

We mentioned 1916 because that is the year Sun Ship was founded. It has long served the swift-growing needs of petroleum and chemical industries. Year by year, the engineering skill and facilities of the great Sun Ship plant have proven their ability to meet the demands for plant and equipment keyed to the swift pace of progress in these and other important fields. Sun Ship keeps pace with progress.

Sun

SHIPBUILDING & DRY DOCK COMPANY

SINCE 1916

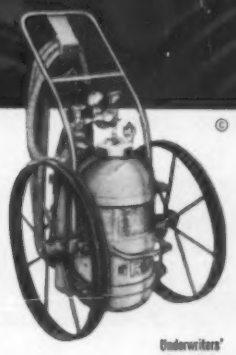
ON THE DELAWARE • CHESTER, PA.

For more data on advertised products, use Readers' Service Cards, last page.

This small fire won't mean tragedy!

America's multi-million dollar Petroleum and Gas Industries are safeguarded from fire by thousands of Pyrene-C-O-Two *safety-engineered* extinguishers and systems!

For all types of flammable liquid fires there are Pyrene-C-O-Two units tailored to your needs. Call your local Pyrene-C-O-Two distributor today for his authoritative advice on fire protection. He carries a complete line of quality extinguishers, systems, brass goods, hose and accessories... and is ready to serve you. Or write to:



Underwriters' Laboratories and Factory Mutual Approved

Pyrene TRADE MARK

C-O-TWO TRADE MARK REG. U.S. PAT. OFF.

PYRENE-C-O-TWO DIVISION

THE FYR-FYTER COMPANY

Dept. PR Newark 1, New Jersey

BRANCHES IN ATLANTA • CHICAGO • DALLAS • DETROIT • SAN FRANCISCO

The exterior stairway and platform on this 100,000-barrel Texas Company storage tank have treads of Multigrip Floor Plate. Their evenly-spaced, flat-topped risers offer positive traction, even when wet.

Two-in-one stair-ramp made non-slip with Multigrip

THE GIANT 100,000-barrel storage tanks at The Texas Company's Port Arthur tank farm have roofs that float up and down. As the fluid level of a tank moves, the roof moves with it, thereby reducing evaporation. To make the shifting roofs accessible from above, The Texas Company installed ingenious stair-ramps. The footing surface of each stair-ramp is made of narrow sections of USS Multigrip Floor Plate.

Stair-ramps are so named because of a cam control which converts the walking surface from ramp to stairway, depending on the height of the floating roof. As a tank empties, the roof sinks, increasing the ramp's angle. When the angle becomes severe, the cam attachment raises one end of each ramp section, thus converting it to a step, automatically.

Safe-Lasting—Footing on every stair-ramp is important. To guard against slipping accidents, The Texas Company chose Multigrip Floor Plate for the foot surfaces. The clean-edged, flat-topped risers give sure-grip traction—wet or dry. Multigrip can be cut, shaped or formed with ease and it stands up under rugged use, year after year. Follow the practice of oil companies all over the country, count on Multigrip Floor Plate wherever safe footing, long wear and low maintenance are important.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, CHICAGO
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

As the floating roof rises, a cam attachment on this stair-ramp lowers one end of each stair tread, thus converting the stairway into a ramp. The stair treads are made of Multigrip Floor Plate.

Close-up view shows why Multigrip's evenly-spaced, flat-topped risers provide all-weather traction on this storage tank stair-ramp.

6-2662

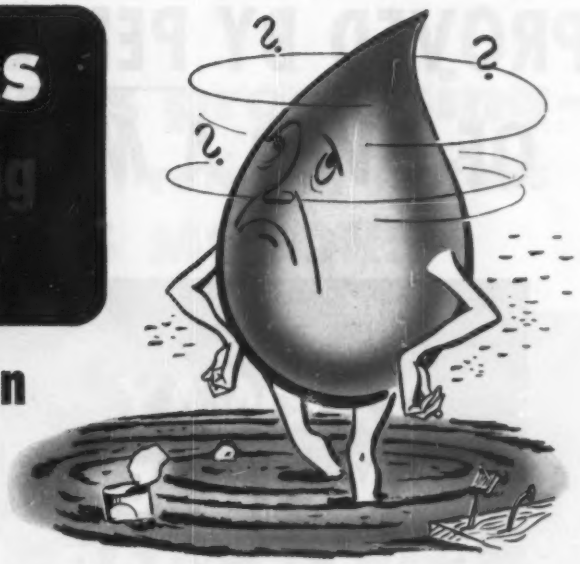
USS **multigrip**

FLOOR PLATE

Sold by leading distributors from coast to coast

UNITED STATES STEEL

ALLIS-CHALMERS
Water Conditioning
ON THE JOB



Reporter finds solution to wide range of water problems

•Raw water is seldom suitable to meet specific requirements of the job. It usually needs some type of conditioning — best determined by a specialist. Here are typical examples of Allis-Chalmers water conditioning experience, equipment and chemicals in use.

Saved $22,000 First Year

Kansas—A chemical company plagued by high steam costs. Their boiler make-up water contained a high solids concentration, requiring a high blowdown rate.

After careful analysis of their problems, an Allis-Chalmers water conditioning engineer recommended Allis-Chalmers Anti-Foam. Use of this chemical resulted in increasing the solids concentration of the boiler water without carry-over. This, in turn, reduced the percentage of blowdown required.

Using A-C Anti-Foam, the company conservatively estimated first year savings of $22,000 in heat, water and chemicals.

* * *

Replacement of Condensate Return Lines Reduced to Practically Zero

Wisconsin—Here in one of the largest malt producing mills, several million pounds of steam are used daily for drying malt.

A special crew used to work all day every day doing nothing but replacing corroded condensate return lines. This, of course, was extremely costly.

Seven years ago, Allis-Chalmers water conditioning engineers were called in. Use of Allis-Chalmers No. 160 return line corrosion inhibitor was suggested.

Piping failures were reduced to the point where they only occur occasionally, and the maintenance crew has been assigned to other duties.

The Customer Is Always Right . . . Well, Most of the Time

East Coast — This plant had been using internal treatment of its boiler water. Chemical costs seemed excessive to management. After analyzing their own situation, they requested bids on a deionizer for treating makeup.

Instead of merely submitting a bid on the equipment specified, Allis-Chalmers engineers analyzed the water and the plant problem. This analysis showed that plant needs were such that a deionizer wasn't needed.

All that was needed was a de-alkalizer. Result: a savings of thousands of dollars.

* * *

The Case of the Dirty Dishes . . . or Don't Blame the Poor Dishwasher

Midwest — A harried plant cafeteria manager placed a frantic call to Allis-Chalmers water conditioning experts. Something was wrong. Glasses were spotty and plates had to be individually wiped off before they could be used. The grumbles were growing in the dining room . . . costs rising in the kitchen. His brand new $30,000 dishwasher wasn't getting the dishes clean, and the supplier of the dishwashing machine said the trouble was caused by the water.

The only trouble with that theory was that he had just installed a water softener the year before. The Allis-Chalmers water conditioning engineer examined the dishes coming out of the water and then asked to see the water softener. The problem was obviously hard water. The unit seemed to be in good working order and the tag indicated the softener had been recharged the previous day.

The maintenance man was called and asked to recharge the softener while an A-C engineer stood by. He went through all the steps—all but one, that is. He failed to close the bypass valve above the softener and practically none of the water went through the softener. It was then learned the operator was new and had not been properly trained.

Needless to say, the maintenance man is now an expert at operating the system, and everyone is pleased with the sparkling dishes.

Moral: A-C engineer's service covers the water front.

Expert Saves Steam for Drop Forge User

North Central — An Allis-Chalmers water conditioning engineer was called in by a manufacturer to supply water conditioning for makeup water. In checking the plant, here's what he found:

A large number of steam-operated drop forges are used by this company. The steam picked up oil from the pistons of the forge and was too contaminated for further use. It was dumped to waste.

He recommended installation of condensate oil removal filters. This was done and today practically all condensate is recovered. Makeup and water conditioning requirements are greatly reduced.

Problems Solved

For an answer to your industrial water problem, call the A-C office nearest you or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

WATER CONDITIONING • CHEMICALS, EQUIPMENT, SERVICE • FOR OVER 25 YEARS

A-C ALLIS-CHALMERS

A-5237

PROVED BY PERFORMANCE OF *OVER A MILLION* TRAPS!

YARWAY IMPULSE STEAM TRAP

the only moving part

...a small stainless steel valve that literally floats on the condensate load. Gets equipment *hot in a hurry*—and *keeps it hot!*

Using a theory of thermodynamics never before applied to steam traps, the YARWAY Impulse Trap revolutionized the industry *20 years ago*. Today over a million YARWAY traps have successfully proved the Impulse principle.

Advantages like the following continue to win new users, convince old users to standardize:

- **QUICK HEAT-UP AND EVEN TEMPERATURES OF EQUIPMENT**
- **GOOD FOR ALL PRESSURES WITHOUT CHANGE OF VALVE OR SEAT**
- **SMALL SIZE—LIGHT WEIGHT**
- **ONLY ONE MOVING PART**
- **STAINLESS STEEL—minimum maintenance**
- **WON'T FREEZE UP**
- **A COMPLETE LINE of sizes and types for every requirement**
- **IMMEDIATELY AVAILABLE from 270 local Industrial Distributors**

For free Trap Selector, or 24 page bulletin, write
YARNALL-WARING COMPANY 128 Mermaid Avenue, Philadelphia 18, Pa.

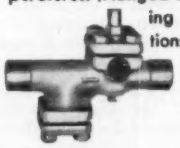
THERE'S A YARWAY IMPULSE STEAM TRAP FOR EVERY NEED

SERIES 60 and 120
For all *normal* trap requirements, pressures to 400 and 600 psi.

½" No. 20-A
For *light loads* on tracer lines, steam mains, small presses, etc.

SERIES 40
For *heavy loads* requiring extra high capacity steam traps

INTEGRAL-STRAINER HIGH PRESSURE TRAP
For *high pressures, high temperatures.* (Flanged or welding connections.)



YARWAY IMPULSE® STEAM TRAP
OVER 1,000,000 YARWAY IMPULSE STEAM TRAPS USED

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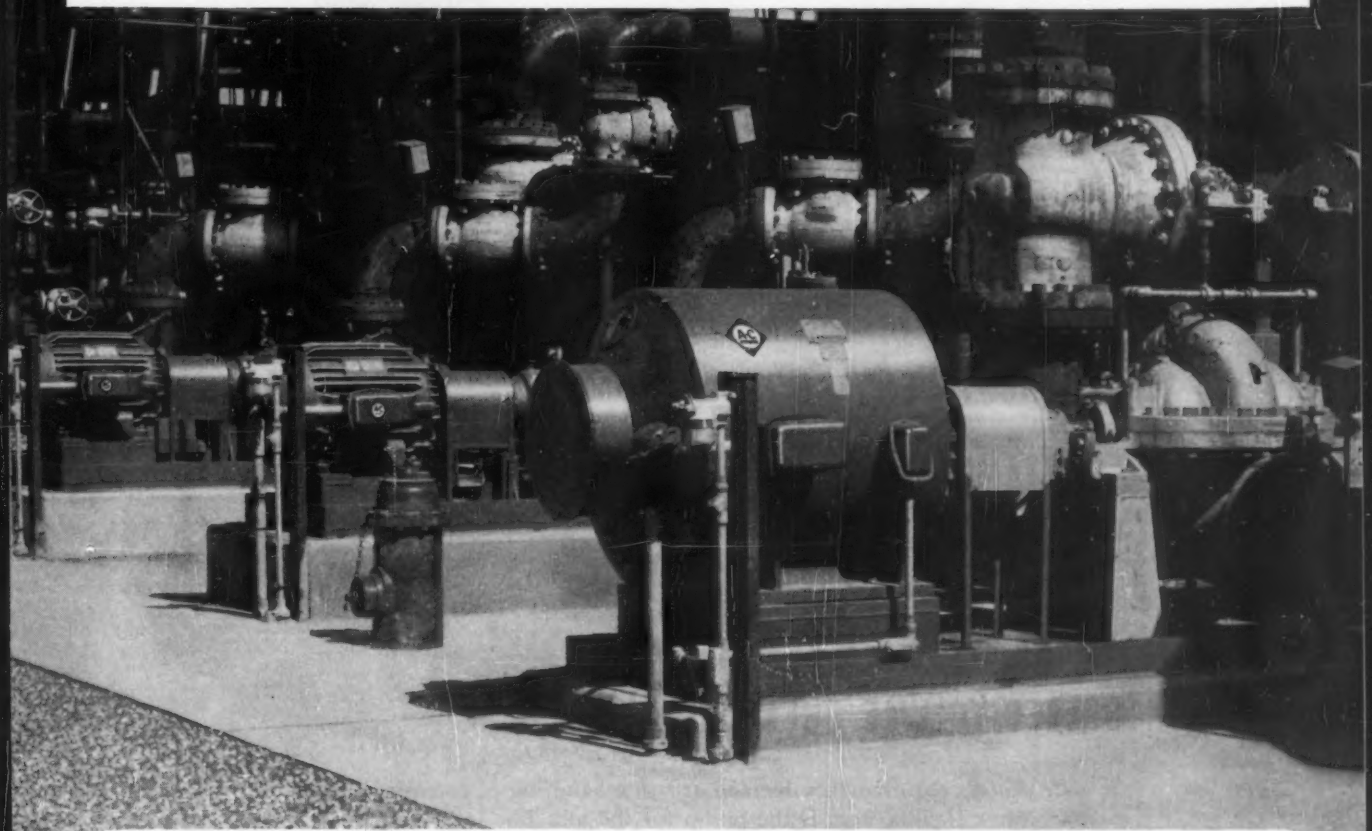
for more continuous processing—

Another great refinery installs

ALLIS-CHALMERS MOTORS



Thousands of horsepower in Allis-Chalmers motors will drive processing equipment at Tidewater Oil Company's new Flying A Refinery, near Delaware City, Delaware.

Designed and constructed by C. F. Braun & Co., consulting engineers and contractors, this plant will process 130,000 bbl of crude oil per day. The largest ever built in a single construction operation, this huge refinery joins a growing list of major petroleum plants in which Allis-Chalmers equipment is used. Main reason for this trend:

Continuous Operation

● **Ribbed Construction** of smaller motors gives up to 43% more cooling surface when compared with ordinary motors. *Tube-Cooled* design in larger sizes permits free flow of air. BOTH designs result in fewer winding burnouts.

● **Motors** are of the chemical type, designed for use in refinery operations.

● **Stators** receive more than the usual dips and bakes. They get extra dips and bakes plus two coatings of red enamel to provide maximum electrical life.

* * *

FIND OUT MORE about Allis-Chalmers motors for the petroleum industry. Contact your nearby A-C sales office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

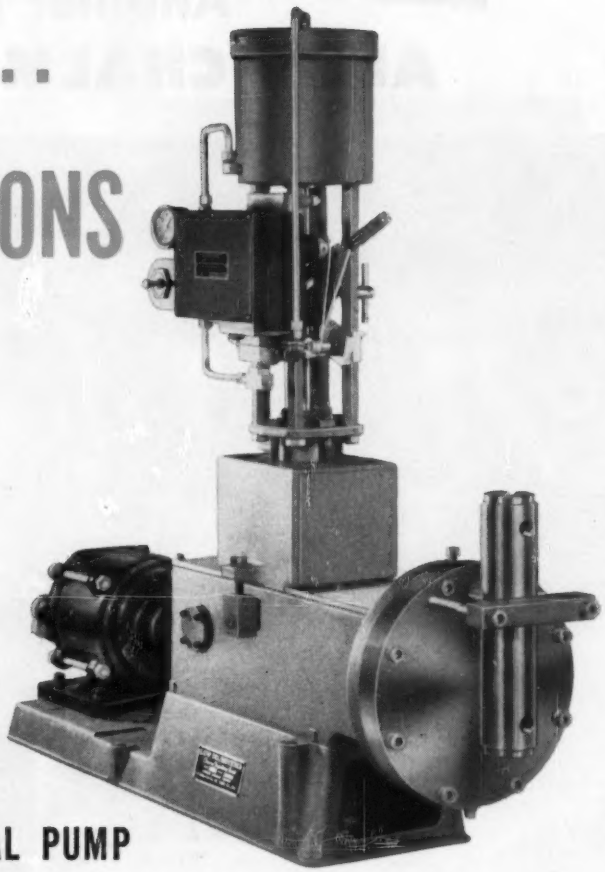
ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5185

IT PUMPS...
IT METERS...
IT PROPORTIONS
IT FEEDS...

WITHOUT LEAKAGE OR CONTAMINATION



Lapp PULSAFEEDER
CONTROLLED-VOLUME CHEMICAL PUMP

If your process requirements demand accurate handling of corrosive and non-corrosive liquids, here is the pump for the job. The Lapp Pulsafeeder is a piston-diaphragm pump . . . it has positive displacement with *no stuffing box.* The product being pumped is isolated from the drive mechanism by a hydraulically balanced diaphragm, thus preventing leakage or contamination of the product. Pumping speed is constant; variable flow results from variation in piston-stroke length . . . controlled manually by hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

WRITE FOR BULLETIN 440 *with typical applications, flow charts, description and specification of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Division, 657 Wilson Street, Le Roy, N. Y.*

Lapp

For more data on advertised products, use Readers' Service Cards, last page.

US RUBBER PACKINGS

SIMPLIFY YOUR PACKING PROBLEMS

these 6 packings will handle most of your requirements

STYLE 193

STYLE 193—U. S. CENTRIFUGAL PUMP PACKING

For centrifugal pumps, or other rotating or oscillating rods or shafts, handling hot or cold, fresh or salt water, oil, brine, weak acids, caustic solutions and ammonia. Made of long fibre asbestos yarn, plaited square. Each strand thoroughly lubricated and graphited.

STYLE 101—U. S. RAINBESTOS HIGH-PRESSURE ROD AND PLUNGER PACKING

Designed for high-pressure steam, air and gas up to 500° F. Made from selected asbestos cloth, woven from tightly twisted asbestos yarn, with a genuine U. S. Rainbow non-hardening cushion, formed square, and treated with heat-resisting lubricants and preservatives and with a graphite solution.

STYLE 101

STYLE 16010—DUCK AND RUBBER

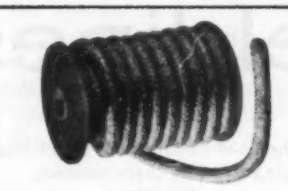
STYLE 16010—U. S. MATCHLESS PACKING

Matchless is the high-pressure packing—will withstand hydraulic pressures as high as 8000 pounds. Self-adjusting, automatic action results in reduced wear and tear on rods and plungers, minimizes friction, keeps down packing costs. For hydraulic equipment, presses, rams, triplex pumps, outside packed pumps, and swivels on rotary drilling rigs.

STYLE 463—U. S. PEERLESS CANVAS PUMP PACKING

For service on inside packed pumps against hot or cold water, and for end rings in hydraulic sets. Made from first quality, closely woven duck laminations cemented together with a high quality rubber friction. Light in weight.

STYLE 463



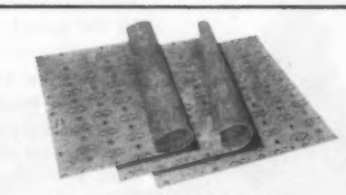
STYLE 125

STYLE 125—U. S. WIZARD ROUND BRAIDED ASBESTOS PACKING

For use in valve stems, reciprocating rods and plungers, against steam, air, hot and cold water, ammonia, oil, chemicals and some acids. Made of long fibre asbestos yarn, braided in round cross-section in the braid-over-braid construction, thoroughly lubricated and graphited throughout.

STYLE 899 (F.O.P.)—U. S. COMPRESSED ASBESTOS SHEET

F.O.P. (Fibre Oil-Proof) is the original oil-proof asbestos fibre high-pressure sheet developed especially for oil industry conditions. Recommended for packing flanges or joints against superheated or saturated steam, air, ammonia, gases, oil, gasoline, water, some acids, alkaline solutions and other chemicals. Ideal for Still Head gaskets. It will not soften, burn, blow or ooze out of a joint, and does not deteriorate with age in stock.



STYLE 899 (F.O.P.)

US RUBBER **Mechanical Goods Division**

United States Rubber

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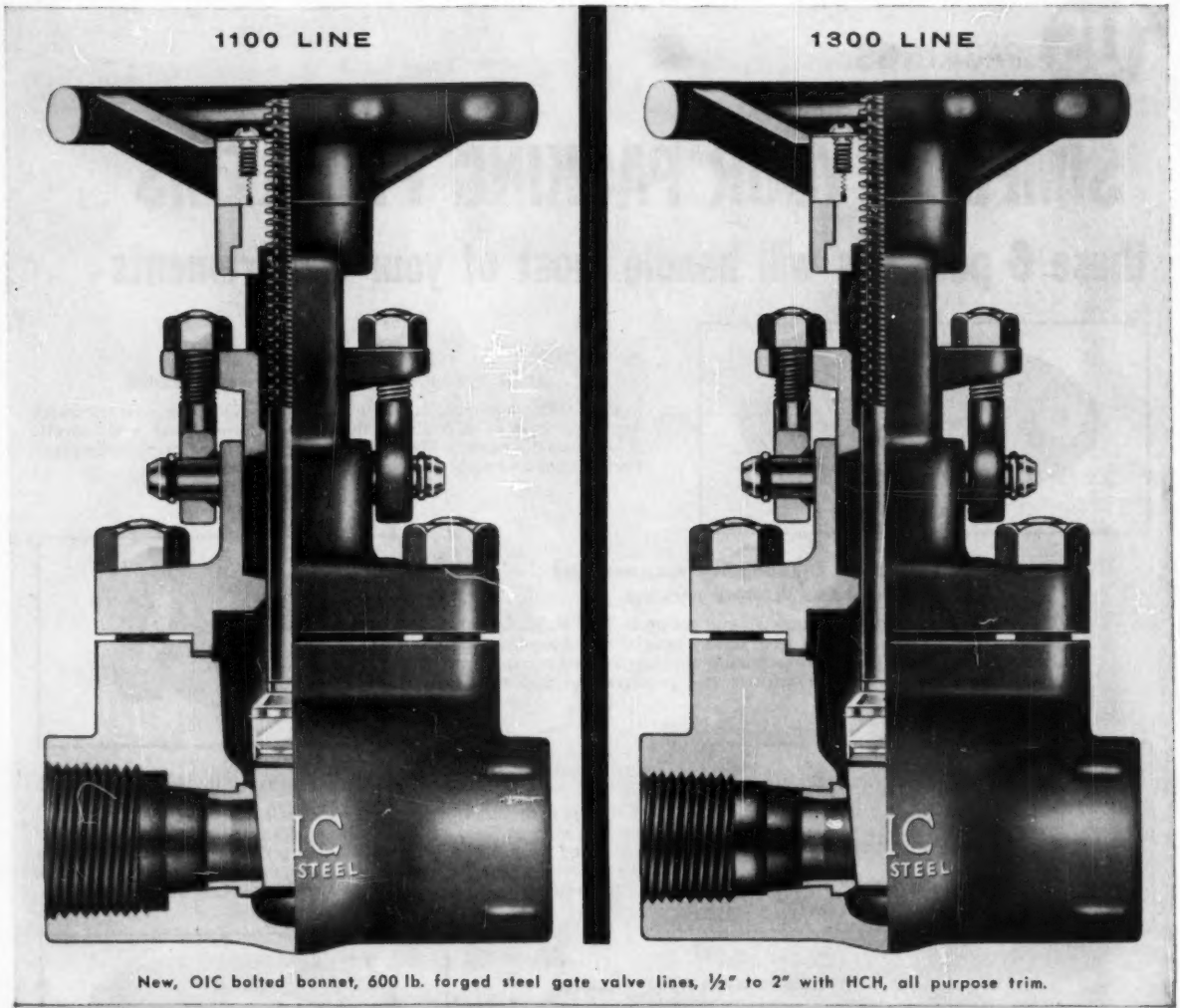


New, OIC bolted bonnet, 600 lb. forged steel gate valve lines, ½" to 2" with HCH, all purpose trim.

2 new rugged OIC forged steel lines

Both feature the modern and rugged bolted bonnet joint, which simplifies and lowers the cost of maintenance.

Both feature a soft iron gasket securely retained in the bolted male and female body-bonnet connection to assure enduring tightness.

Both feature 13% chrome stainless steel trim with 1000 Brinell, duracased wedges.

Both feature plenty of gripping area for pipe wrenches on pipe ends; there's no interference with body-bonnet flanges. Simplifies joint make-up!

The 1300 line includes a *high flow* port area, offering full-flow characteristics.

The 1100 line, with standard flow ports, is compact, economical, and includes the same high quality, rugged features and trim as the 1300 line.

Most valve users have applications suited to both of these new OIC valve lines. Write for Bulletin *#195-R* illustrating features and specifications that fit these newest forged steel valves to your services.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG; BRONZE & IRON VALVES**

For more data on advertised products, use Readers' Service Cards, last page.

YOU, too, CAN BE SURE

petrochem-isoflow furnaces

are most economically desirable

by any comparison

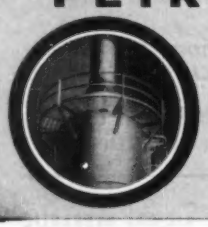
Whenever *all* the specifications and *all* the operating requirements are applied to direct-fired furnace design, you can be sure PETROCHEM-ISOFLOW FURNACES will be found most economically desirable, by any comparison.

In making comparisons it is essential to take these factors into consideration:

1—Average radiant transfer rate.
2—Maximum deviation from average radiant transfer rate.
3—Average and maximum transfer rate in convection section.
4—Maximum tube wall temperature, radiant or convection.
5—Maximum efficiency with specified excess air.
6—Controlled thermal recirculation of flue gases to provide even heat distribution throughout full length of each tube and equalized heat distribution around each tube.
7—Overload and corresponding transfer load.
8—Design to provide: structural column supports—Ladders—Platforms—Tube Removal facilities, etc.
9—Degree of assembly; of the furnace structure and of the heating surface.

When you specify PETROCHEM-ISOFLOW FURNACES . . . you'll be in good company. More than 1500 are now in service, performing to the complete satisfaction of their operators and usually well beyond their rated capacities.

PETROCHEM-ISOFLOW FURNACES



UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INC. • 122 EAST 42nd St., New York 17, N. Y.

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Rawson & Co., *Houston* • Wm. H. Mason Co., *Tulsa* • Lester Oberholtz, *Los Angeles* • Faville-Levally, *Chicago* • D. D. Foster, *Pittsburgh* • Turbex, *Philadelphia* • Flagg, Brackett & Durgin, *Boston* • G. M. Wallace & Co., *Denver & Salt Lake City*

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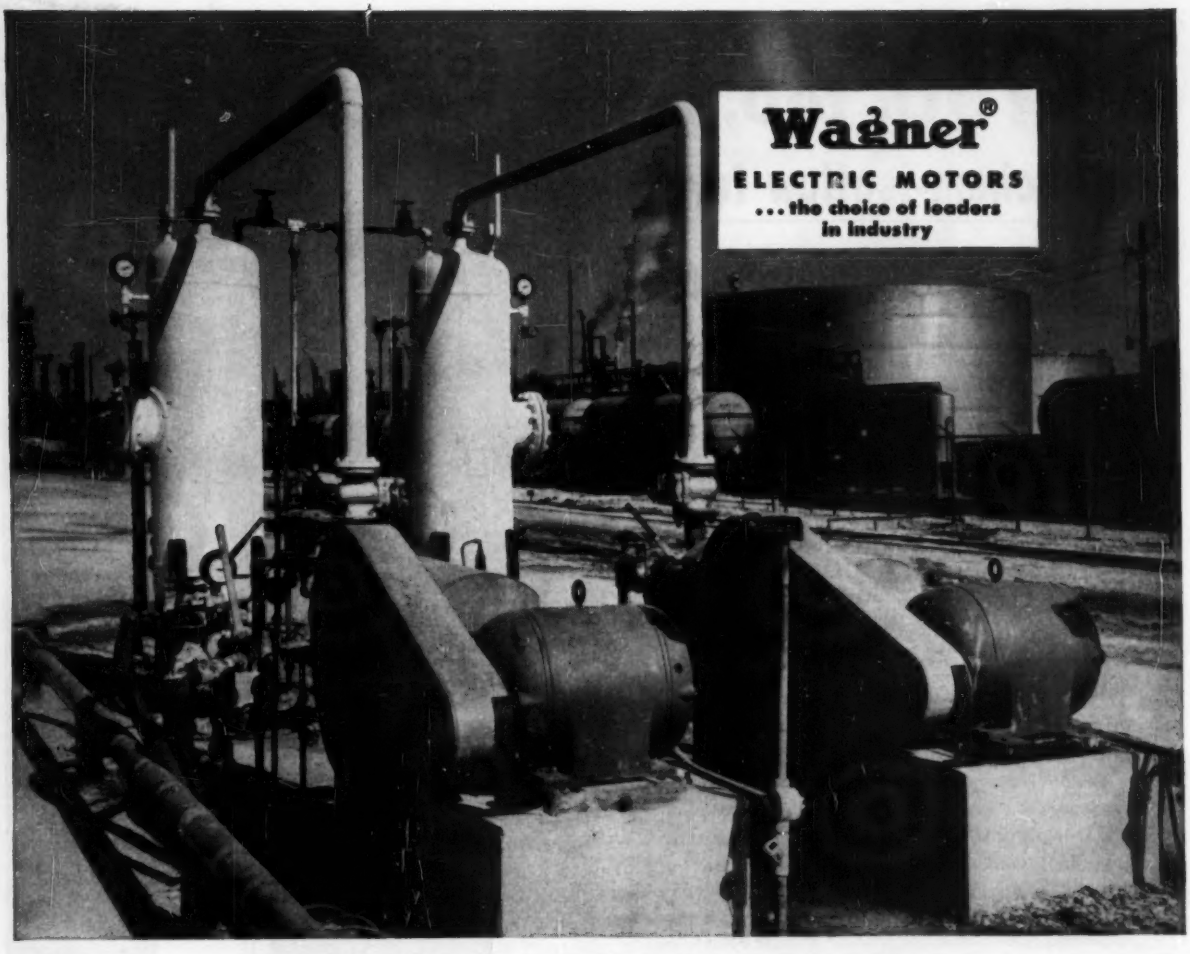


Protected against explosion
WAGNER JP MOTORS

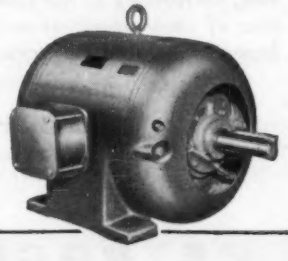
A single spark in a hazardous atmosphere can mean the end of refinery production . . . to say nothing of possible loss of life and millions of dollars in damage from fire and explosion.

Wagner Type JP Explosion-Proof Motors are expressly built for applications in hazardous atmospheres. They're perfect for the job . . . that's why they're the time-tested favorites of the petroleum industry—in pumping stations and in refineries. They are approved by Underwriters' Laboratories for Class 1 Group D hazardous locations. These motors are available in a complete range of ratings through 250 hp, normal torque and high torque.

In addition to these explosion-proof motors, Wagner also maufactures a line of drip-proof 40°C. polyphase motors, in ratings through 75 hp, especially designed for the continuous outdoor service demanded by oil well pumping applications. High power factor type capacitor oil well pumping motors are available for use where single-phase motors are required.

Write for Bulletin MU-132 on Cast Iron Frame Motors and for Bulletin MU-137 on Oil Well Pumping Motors. Thirty-two branch offices are ready to assist you in any motor application problem.

This Wagner Type JP Explosion-Proof, cast iron motor, with frames and end-plates of cast iron, is suitable for indoor or outdoor use and for installations where corrosion is a problem . . . as well as for general applications.



Wagner Electric Corporation
EST. 1891

Wagner Electric Corporation
6458 Plymouth Ave., St. Louis 14, Mo., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

M56-3

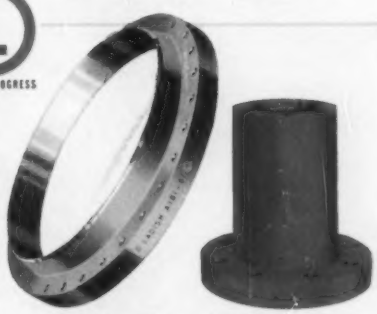
ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS-AIR AND HYDRAULIC

BUTT WELDING FITTINGS
(IPS)

ASA and MSS FLANGES

L
TO MARK PROGRESS

BUTT WELDING FITTINGS
(TUBE O.D.)



LARGE O.D., TEMA and
LONG WELDING NECK FLANGES

UNIONS

SCREWED and SOCKET FITTINGS

LADISH

FOR *Complete Service* IN *Controlled Quality* FITTINGS

CARBON • ALLOY
AND STAINLESS STEELS

WHATEVER your fittings requirements . . . regardless of the type, size, wall thickness, pressure rating or material specification . . . you can get prompt, efficient, *complete service* by specifying LADISH and ordering from your local Authorized Ladish Distributor.

A broad, full-range line produced to unsurpassed standards of metallurgical and manufacturing integrity . . . plus adequate local stocks . . . gives you double assurance of satisfaction.

For complete service on your fittings requirements . . . call your Authorized Ladish Distributor.

Catalogs available on request. Please indicate specific product lines for which information is desired.

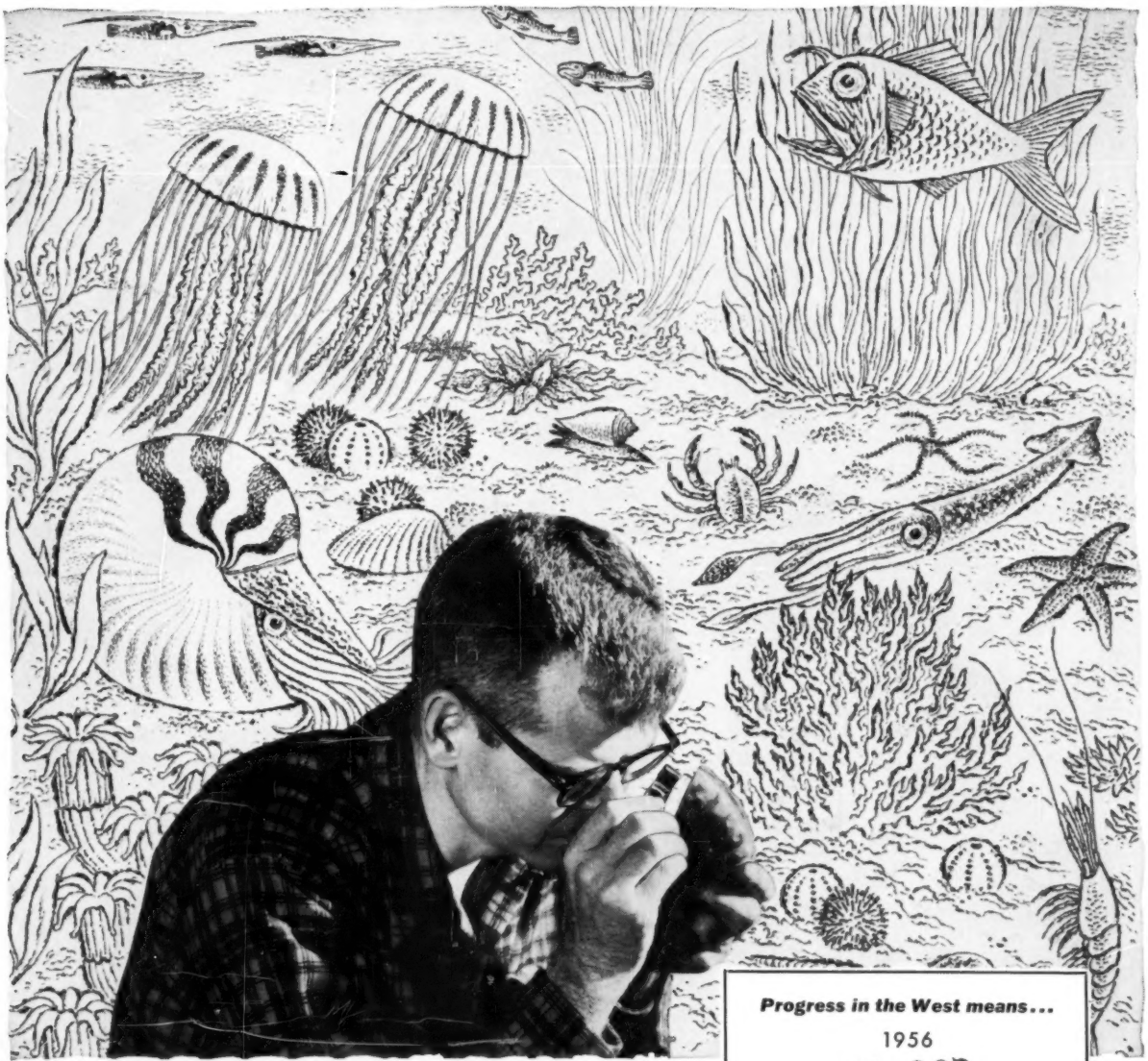
THE COMPLETE *Controlled Quality* FITTINGS LINE

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland
Chicago • St. Paul • St. Louis • Atlanta • Houston • Odessa • Tulsa • Denver
Los Angeles • San Francisco • Seattle • Havana • Mexico City • Brantford, Ont.

Standard's educational program helps provide college training for 286 students this year



Industry needs many trained minds with specialized knowledge. For example, the paleontologist who supplies accurate data for oil exploration by studying fossils of marine life from millions of years ago.

THEY CALL THIS THE ATOMIC AGE . . . the era of the "thinking" machine. But above all, this is the age of *human* thought. For today our country needs more and more skilled minds to harness our atoms, advance our culture and guide our government. Standard, too, needs fresh concepts to maintain its position in a highly competitive business. That's why this year Standard's educational program makes available, through colleges, 234 scholarships for undergraduate study, 52 fellowships for graduate work, plus a series of grants to universities.

In these ways, Standard affords young people a better opportunity to contribute to their professions and communities.

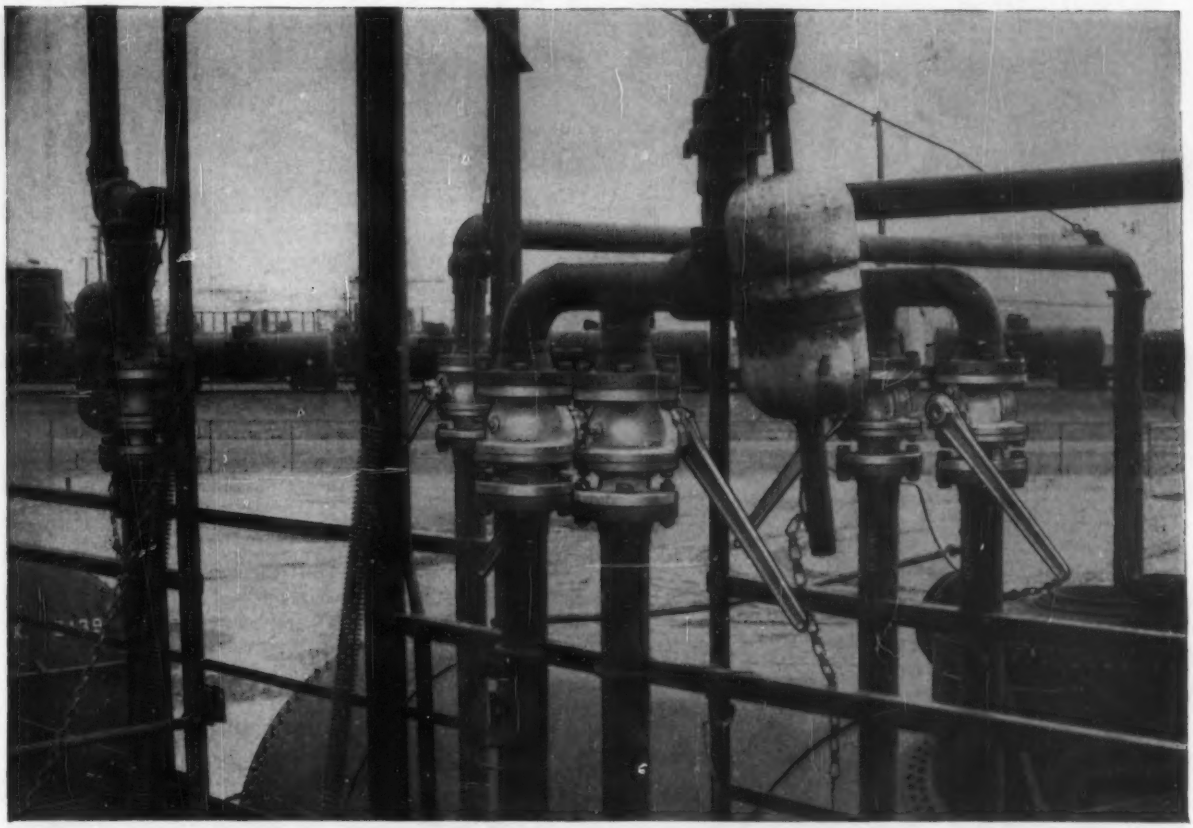
Progress in the West means...

1956

trained people will be needed to fill 2½ million new jobs by 1965

1965

STANDARD OIL COMPANY OF CALIFORNIA



He said leaking couldn't be stopped

...but Rockwood Ball Valves stopped it!

The resident engineer of a major oil company was skeptical when we told him about the exclusive features of Rockwood Ball Valves. It was impossible, he said, to keep racks free from messy oil conditions due to drippings from valves. But he agreed to replace his old style valves with Rockwood Valves.

He was surprised at the result — *absolutely no leaking from Rockwood Ball Valves.*

It's easy to see why Rockwood Ball Valves are leakproof when you examine them. You'll find—

Full Round Pipe Size Flow — no change in shape or volume of fluid stream — no turbulence — no minimum loss.

Quick Opening and Closing — only a quarter turn needed.

Longer wear resistance — Chrome-plated bronze ball withstands abrasion, pitting and scratching.

Leakproof Seal — pressure of fluid automatically positions ball against seat to form tight seal.

It works as good as it reads! Send coupon today for complete information. Rockwood Ball Valves come in all pipe sizes. Tested and listed by Underwriters' Laboratories, Inc. Distributors in all principal industrial areas.

ROCKWOOD BALL VALVES

FULL, ROUND FLOW

ROCKWOOD SPRINKLER COMPANY
1288 Harlow Street
Worcester 5, Mass.

ROCKWOOD

Send me illustrated folder V-4 on Rockwood Full-Flow Ball Valves.

Name.....

Title.....

Company.....

City.....Zone....State.....

For more data on advertised products, use Readers' Service Cards, last page.

Sherman Power Digger Digs Six to Eight 60 Foot Trenches, 7 Feet Deep, in a Single Day!

Five Sherman Power Diggers, averaging 40 hours of work each, every week, are doing more than their share to maintain the position of Bell Plumbing and Heating Co., Denver, as one of the nation's major contractors.

As Mr. William Stecher, plumbing superintendent for Bell, puts it, "We have found that this equipment can dig six to eight sixty-foot ditches a day. All of them are seven feet deep. I would guess that each machine does the work of six men at about one half the price."

In addition to digging trenches for water and sewer lines, the Shermans are used for a variety of other digging and trenching jobs about the building sites.

With their Shermans on the job, Bell Plumbing and Heating no longer has to sub-contract normal digging jobs. Before purchasing the units, schedules often had to be adjusted for the sub-contractor and delays of several days were not uncommon. Now, work is completed on schedule.

Sherman Power Diggers can cut costs and speed production for your company, too. See your local Ford Tractor dealer TODAY for a demonstration or write for free Bulletin No. 3350.

See the Sherman Power Digger soon at your local **FORD TRACTOR DEALER**

Sherman
PRODUCTS, INC.
ROYAL OAK, MICHIGAN
POWER DIGGERS* • FRONT END LOADERS • FORK LIFTS
Sherman SP Products

*Designed, Engineered and Manufactured jointly by Sherman Products, Inc., Royal Oak, Michigan. Wain-Roy Corporation, Hubbardston, Mass.

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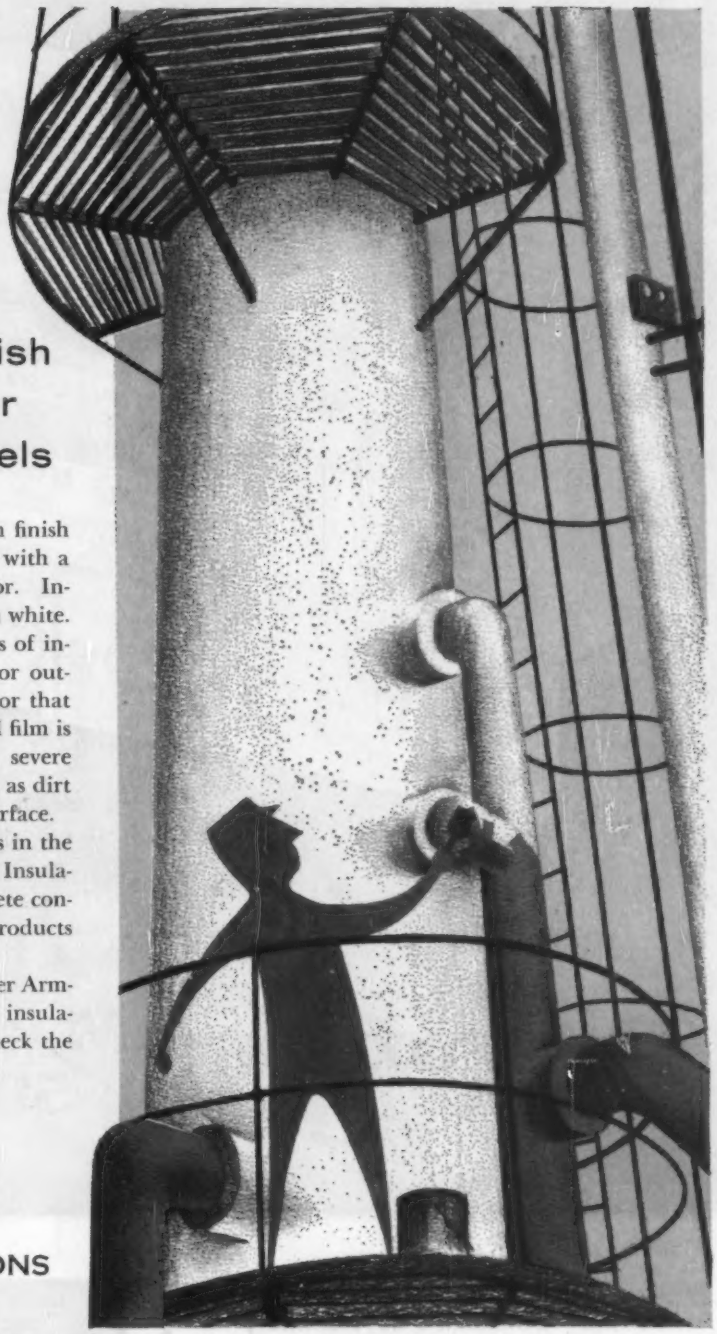

Rugged insulation finish for indoor and outdoor lines, tanks, and vessels

Reduce insulation costs by providing both finish and color identification at the same time with a protective coating of Armstrong Insulcolor. Insulcolor comes in seven colors, plus a clean white. It is applied by brush or spray to all types of insulated lines, tanks, and vessels, indoors or outdoors. There are no solvents in Insulcolor that create a hazard during application. Dried film is fire-resistant, and lasts for years under severe weather conditions. Maintenance is easy, as dirt washes readily from Insulcolor's smooth surface.

Insulcolor is one of the quality products in the complete line of Armstrong Industrial Insulations. Armstrong also offers you a complete contracting service, geared to install these products economically and efficiently.

For full details on Insulcolor or any other Armstrong materials that may help solve your insulation problems, send for free booklets. Check the ones you want on the coupon below.

Armstrong

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☐ Armstrong Insulcolor®, Weatherproof Coating in Seven Colors

☐ Armstrong LT Cork Covering, a New Type Cold Line Insulation

☐ Armstrong Armaglas Insulations for Pipes, Tanks, and Vessels

☐ Armstrong Armaflex*, a New Flexible Insulation for Piping

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Armstrong Cork Company
2501 Ream Ave.
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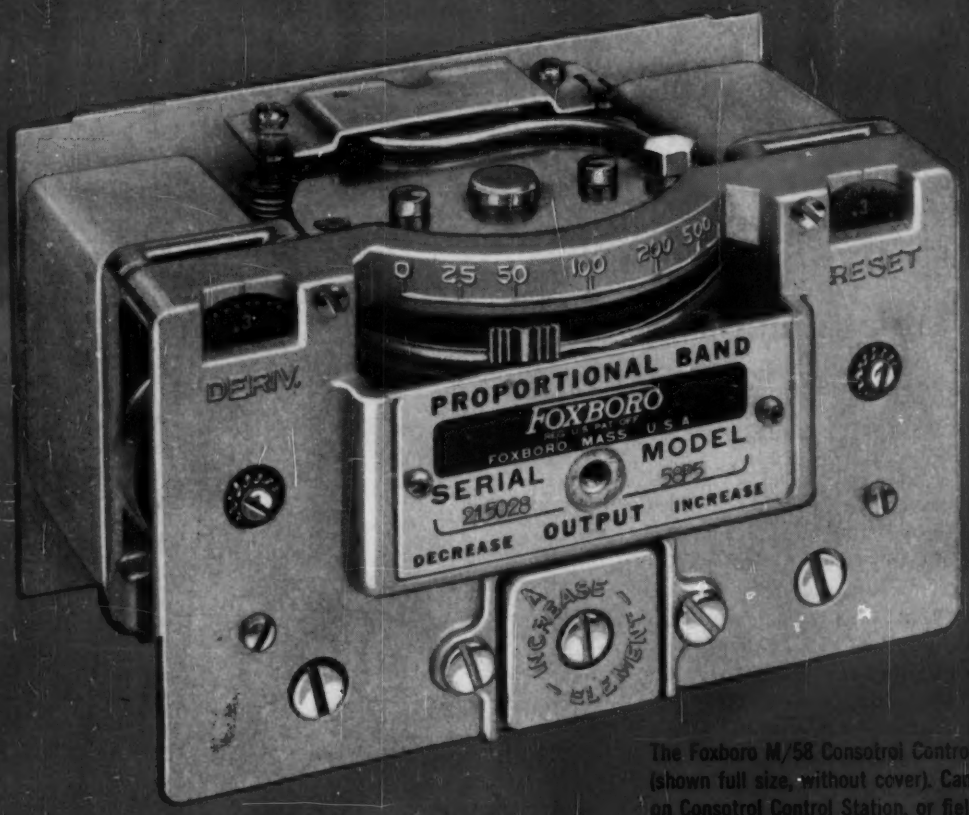


The Foxboro M/58 Consotrol Controller (shown full size, without cover). Can be panel-mounted on Consotrol Control Station, or field-mounted.

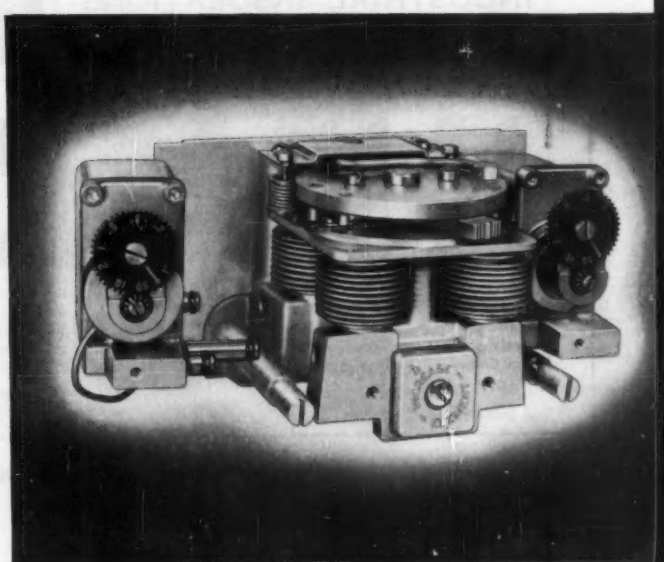
THE FOXBORO M/58 CONSOTROL

The M/58 Controller's Revolutionary Floating Disc System

Here's the exclusive Foxboro design development that gives M/58 Control its unique versatility, precision, and stability. The floating disc and matched bellows assure uniformly high controller sensitivity and pin-point control action, even at widest settings of the proportional band. Lever-set proportional band adjustment is calibrated to 500%.

Component Construction Gives Unrivaled Versatility

Not only is the complete controller easily detachable as a unit, but also, each component is a "plug-in" unit. For example, reset plugs in at right as shown; derivative, similarly, at left. All 4 control actions, with 2 reset ranges, are available and easily adjustable to widest variations in operating conditions. Proportional action from 1 to 500% quickly set by lever.



Outperforms all other controllers!

...the controller with the FLOATING DISC

If you think this claim is exaggerated, just put a Foxboro M/58 Consotrol* Controller on your process. The tougher the job, the more it will outperform other controllers! Or ask any present user . . . many of the largest, most progressive petroleum and chemical processors are using hundreds of these instruments. They will unhesitatingly confirm that this exclusive Foxoboro development has put their processes "on stream", automatically and smoothly from the control room, without false starts or confusion.

The M/58 Controller can do the same for your process. The flexibility of its control functions makes it readily adaptable to *all* processing techniques. All four actions are available, with two ranges of reset . . . all are easily adjustable to the most widely varying operating conditions. For example, reset and derivative functions plug in . . . proportional action from 1 to 500% can be quickly set by a lever. And calibration is a simple zero adjustment!

Get full details on this simple, truly "universal" Controller. Write for Bulletin 13-19 and ask your Foxboro Sales Engineer for a demonstration. The Foxboro Company, 741 Neponset Avenue, Foxboro, Mass., U.S.A.

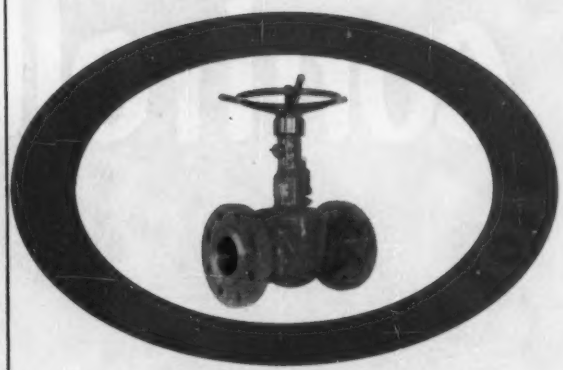
*Reg. U.S. Pat. Off.

FOXBORO
Reg. U.S. Pat. Off.

CONSOTROL INSTRUMENTS

Venturi Type — available sizes: Flanged End only, ASA Class, 2, 2½, 3, 4 & 6 inches, beginning with 150 lbs., thru 2500 lbs., Carbon & Stainless Trim.

ORBIT



LONG-RANGE SAVINGS WITH LONG-LASTING ORBIT VALVES

Full Round Opening sizes available in Flanged & Screw End ASA Class, 1, 1½, 2, 2½, 3 & 4 inches, beginning with 300 lbs., thru 2500 lbs., Carbon & Stainless Trim.

Plant maintenance men know that Orbit Forged Steel ASA Class Valves have established an outstanding record for trouble-free service. And that is why these key operating men ask for ORBIT VALVES for new plant construction, replacement and expansion programs. Maintenance is extremely low on Orbit valves—they are built to give long years of trouble-free service —and this adds up to long-range savings.

ORBIT VALVES®

WAREHOUSES: **Houston, Texas,** 407 Velasco, CApitol 8-6623, TWX HO 115; **Odessa, Texas,** 402 West County Road, FEderal 7-2263, TWX ODESSA TEX 8041; **Casper, Wyoming,** 247 West First St., Phone 3-5707, TWX CP 394; **Long Beach, California,** 1425 West 15th Street, HEmlock 7-6206; **Edmonton, Alberta, Canada,** 7119-104th Street, Phone 391-283
CANADIAN REPRESENTATIVE: T. R. Pickford & Company, Ltd., Calgary, Alberta, 536 8th Avenue West, Phone 2-7371
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ORBIT VALVE COMPANY

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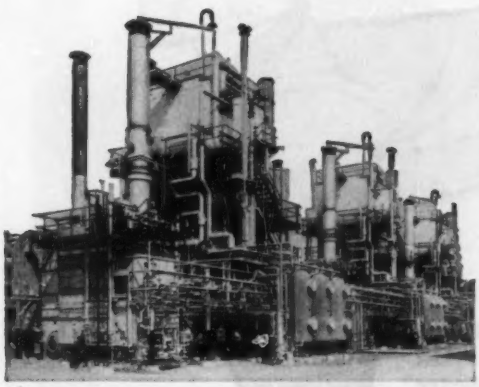
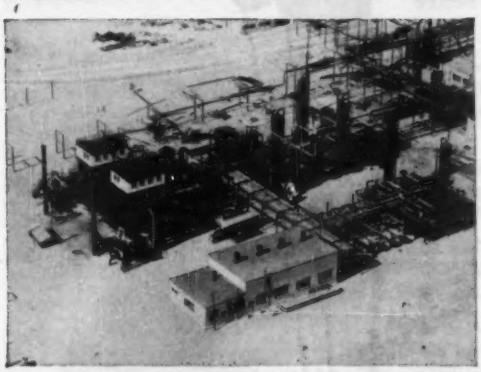
HYDROGEN
...how much do you need?

Girdler offers you complete engineering-construction service for BIG-CAPACITY *plants*





When you plan facilities for "tonnage hydrogen" for treatment of refinery feed stocks and hydrocarbon products, it will pay you to take advantage of Girdler experience.

Big plant experience: Girdler has designed and constructed large plants for petroleum products and chemicals. Two hydrogen plants have been built each of which can produce gas at the rate of seventy million cubic feet per day. More than 45 Girdler hydrogen plants are giving outstanding performance in the United States and Canada.

Girdler manufactures all of the catalysts used in Girdler hydrogen plants. These catalysts permit high production rates.

Call or write for complete information

the **GIRDLER** Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY
LOUISVILLE 1, KENTUCKY

GAS PROCESSES DIVISION • DISTRICT OFFICES: New York, San Francisco

For more data on advertised products, use Readers' Service Cards, last page.

Your Company Got the BENDS?

If you've got the bends...pipe bends, that is...stop and think a moment about this: ADSCO Expansion Joints will do a better job because of...

● ***LESS HEAT LOSS.*** A 12-inch line 1000 feet long, carrying steam at 200 lbs. and 550 F. will lose 16% more heat if bends are used instead of ADSCO Expansion Joints.

● ***LESS PRESSURE DROP.*** The same line will have a 28% greater pressure drop with bends than with ADSCO Expansion Joints.

● ***LESS SPACE.*** One pipe bend requires 50 or 100 cubic feet of valuable space. ADSCO Expansion Joints require no extra space.

● ***LOWER COST.*** Used to absorb 4 inches of expansion per 150 feet of 12-inch pipe, an expansion bend, or loop, will cost 50% to 100% more than an ADSCO Expansion Joint. Similar savings will result from the use of ADSCO Expansion Joints in other sizes of pipe lines.

If you are planning construction of a pipe line or modernization of an existing one with bends, ADSCO invites inquiries on the use of Corruflex Packless or Slip-type Expansion Joints.

Write for Bulletins 54-10PR and 35-51-PR.

AMERICAN DISTRICT STEAM DIVISION
ADSCO INDUSTRIES, INC.
20 MILBURN ST. BUFFALO 12, N. Y.

ADSCO
ENGINEERED
PRODUCTS

Inside Story on POWELL STEEL VALVES

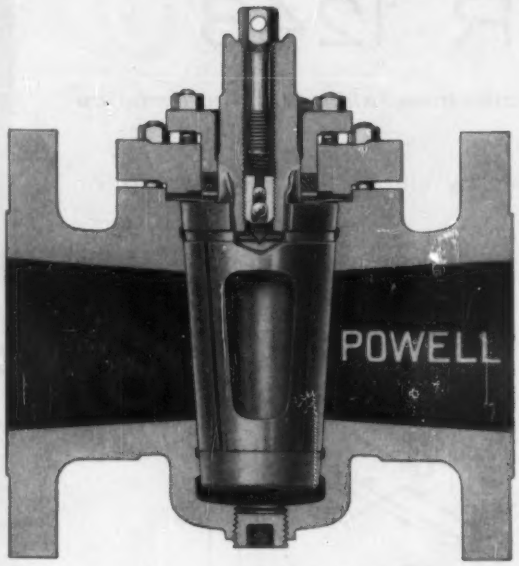


FIG. 3059—(Sectional)—A.S.A. 300-pound Steel Lubricated Plug Valve.

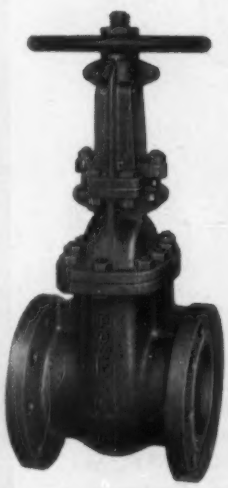


FIG. 2456 SS—OS&Y Gate Valve—1/16 Raised Face Separate Yoke Arms. Flanges are in accordance with ASA B16.5.

Steel Valves may appear similar on the outside. But their performance may be quite another story—for there can be a big difference in the metal, in design and in manufacture. And the inside story on Powell Steel Valves is that every valve has PERFORMANCE VERIFIED.

Only the finest materials are used in Powell Steel Valves. And painstaking quality control is rigidly enforced through each step of manufacture. For example, every machining operation is accurately gauged. All parts are thoroughly cleaned and degreased. As a final step in manufacture, EVERY POWELL STEEL VALVE IS GIVEN AN ACTUAL LINE TEST.

Because of Powell's painstaking quality control, plant shutdown through valve failure is practically unknown. Records from refineries, power and industrial plants the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our COMPLETE quality line which has PERFORMANCE VERIFIED.

Fig. 2433 SS—Stainless Steel Bolted Cap Swing Check Valve for 150 pounds W.P.

PERFORMANCE PV VERIFIED

The Wm. Powell Company, Cincinnati 22, Ohio . . . 111th YEAR

POWELL VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES

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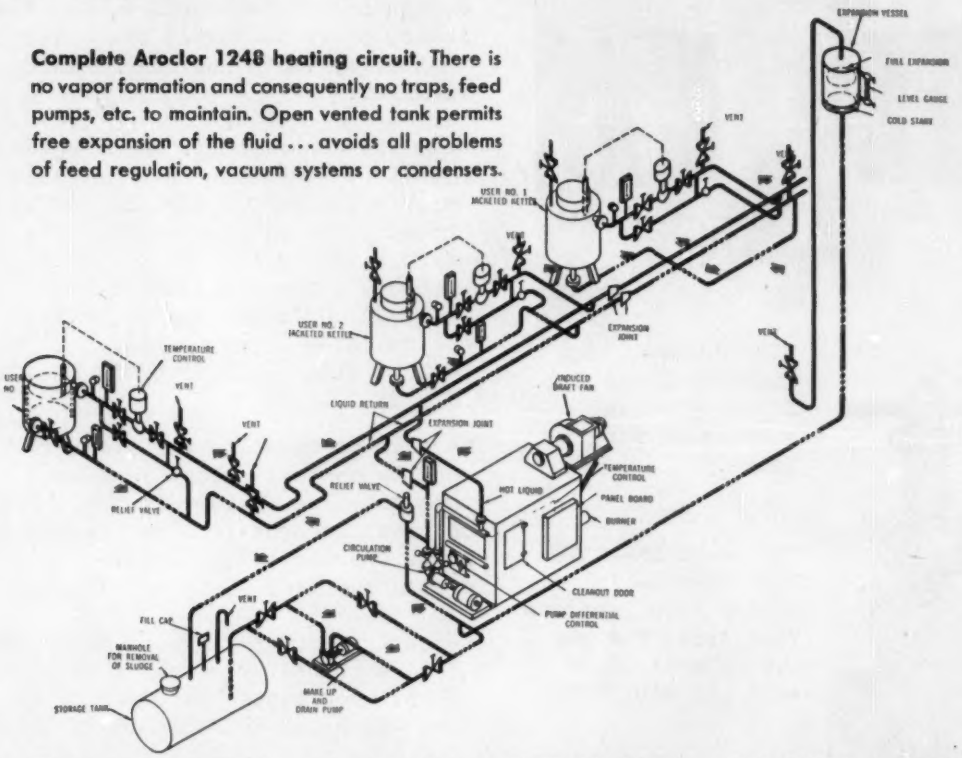
Now . . . **NON-PRESSURIZED** liquid-phase heat systems that operate up to **600°F.**

AROCLOR 1248

Operates at atmospheric pressure...cuts installation and maintenance costs of expensive pressurized systems.

Fluid is fire-resistant...increases safety by eliminating direct-firing, or heat transfer with flammable fluids.

Complete Aroclor 1248 heating circuit. There is no vapor formation and consequently no traps, feed pumps, etc. to maintain. Open vented tank permits free expansion of the fluid . . . avoids all problems of feed regulation, vacuum systems or condensers.



The Equipment . . . capacities can range from small portable units—usually electrically heated—to large gas- or oil-fired units generating from 250,000 to over 10,000,000 B.T.U.'s per hour. Circuits are closed, forced-circulation. Compact design saves space, minimizes installation and maintenance costs.

The Fluid . . . Aroclor 1248 is a highly stable chlorinated polyphenyl; does not support combustion up to its boiling range 652° to 725° F.; has autogenous ignition temperature of extremely high 1299° F.; is non-corrosive. Aroclor 1248 operates in most systems four to seven years without replacement.

MONSANTO

Where Creative Chemistry Works Wonders For You

Contact Monsanto for SOURCES of AROCLOR 1248 heating systems

Write to us on your company letterhead. We will send you technical information about Aroclor 1248 and/or the names of Aroclor 1248 heat-transfer system manufacturers and designers. Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Dept. IF-2, St. Louis 1, Missouri.

AROCLOR: Reg. U. S. Pat. Off.

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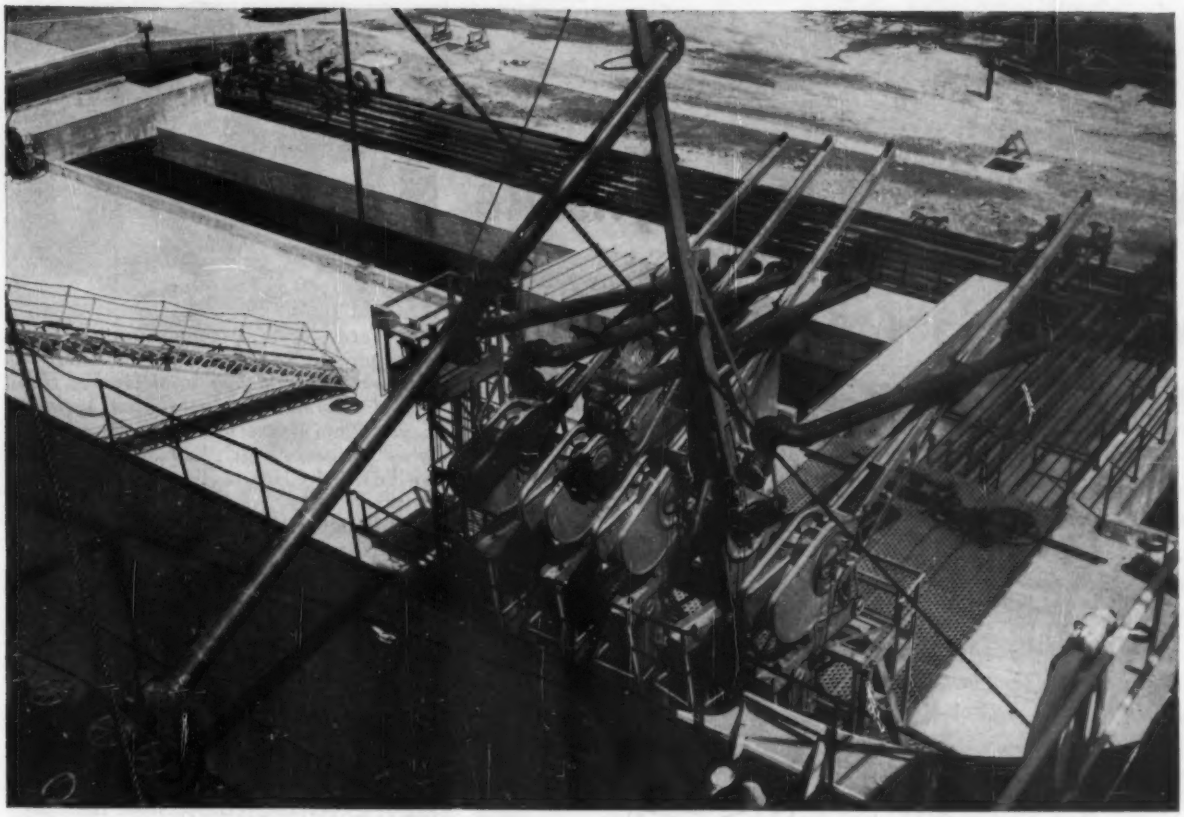
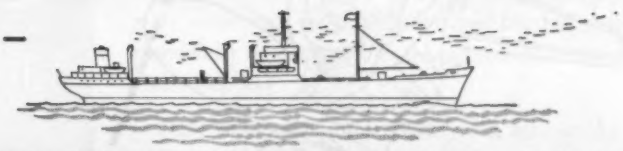


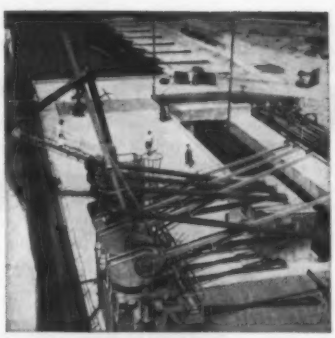
IN SHIPPING—



CHIKSAN MARINE LOADING ARMS

GIVE A MODERN DAY LIFT TO TANKER LOADING!

Hooking up hose lines to a tanker is often a rough, dirty, and sometimes dangerous task. However, loading drudgery is becoming just a memory wherever the new Chiksan Marine Loading Arm has gone into service. Heralded by many as the first basic improvement in the loading of marine tankers in over 30 years, the new Chiksan Loading Arm not only insures faster tanker turn-around time, but promises material savings of lost man-hours due to hose handling injuries, insurance and compensation premiums, and expensive rubber hose replacements. Savings within a decade, one customer estimates, will actually amount to the purchase price of a 5-arm unit. For descriptive literature, write Chiksan, Brea, California.



Where once a crew of seven men labored for 30 minutes to hook up a rubber line, now one man operating hydraulic controls can swing a Chiksan Loading Arm aboard, for hook up, in less than a minute.

Please Address
Dept. 51

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

fmc CHIKSAN®

CHIKSAN COMPANY—BREA, CALIFORNIA • CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY

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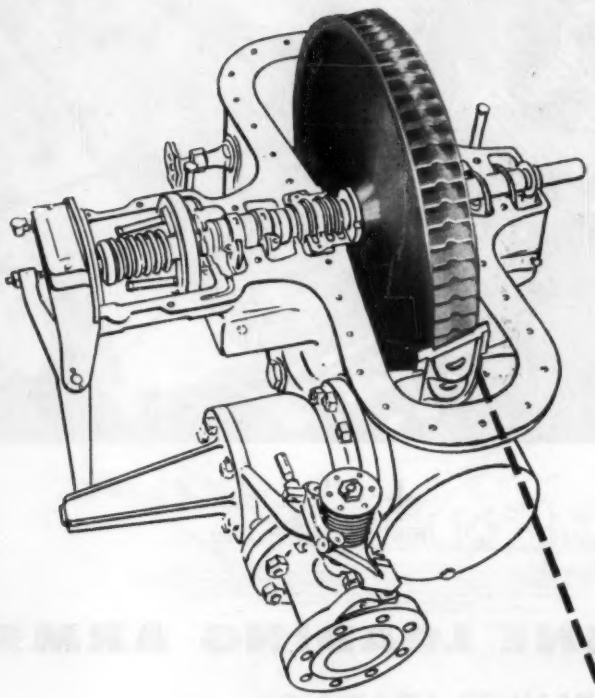
Work Horse of Industry..since 1906



The Terry Steam Turbine Company was incorporated in 1906 to manufacture *a workable and efficient prime mover that would operate with minimum maintenance.* This prime mover was the solid-wheel turbine, which had been invented by Edward Clinton Terry a few years before.

Although maintenance practice has improved vastly since then, the demand for the turbine has multiplied many times. *Rising maintenance costs have actually increased the need for trouble-free operation.*

Today, there are more Terry solid-wheel turbines in operation, and there are more built each year, than ever before. The explanation is simple.

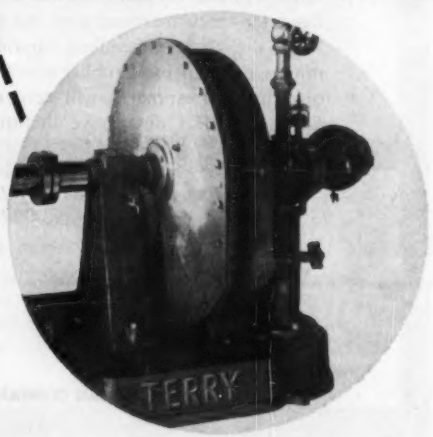
Here is a turbine with a virtually indestructible wheel. Made of a single forging of special composition steel, there are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which may occur does not materially affect horsepower or efficiency.

Blades will not foul. They have large clearances and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

These are a few of the reasons why the Terry solid wheel turbine has been the *work horse of industry — since 1906.* For the full story, send for a copy of Bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



1906 was the year this turbine was built in Terry's plant. It is believed to be one of the first small direct-connected turbines built for commercial use in the United States.

TT-1203

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Our Lubrication Engineers worked with Engine Designers, then put

EXTRA anti-wear protection in AEROLUBE® 93-C!

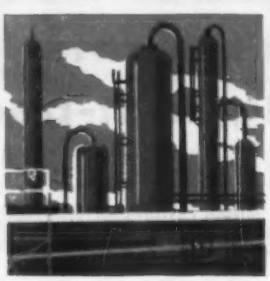
Top anti-wear characteristics are specifically formulated into Cyanamid AEROLUBE 93-C inhibitor to give the extra protection required in engine break-in, severe service or other problem conditions faced by lubrication engineers. This concentrated zinc dithiophosphate inhibitor safeguards stability—it is an excellent oxidation inhibitor that prevents formation of harmful peroxides and organic acids. It sharply reduces wear of valve lifters and other critical engine parts.

Zinc dithiophosphate has proved itself to be one of the most effective additives for commercial lube oils. Maximum wear resistance, oil stabilization and bearing protection, demanded by modern engines, have been built into Cyanamid's AEROLUBE 93-C.

Light color and compatibility with lube stocks and other additives, make AEROLUBE 93-C outstanding for use in premium oil products—for regular use as well as initial fill.

AERO® HDS CATALYST

In modern hydrodesulfurization processes, Cyanamid's new AERO HDS Catalyst contributes highest available volume activity and excellent mechanical properties. Cyanamid's specialized catalyst know-how may be helpful in initiating or improving your hydro-treating operation.



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At Stamford, Connecticut, the Refinery Chemicals Department of Cyanamid maintains laboratories unsurpassed in the refining field for basic research and development in catalysts and other refinery chemicals. As a part of extensive research and pilot plant facilities, specialized equipment and methods—such as the electron microscope and vapor-phase chromatography—are used to develop information leading to improved products which give optimum performance under field conditions.

Our field men are constantly absorbing new developments at the research, development and operating levels. In this way, your Cyanamid man keeps abreast of the petroleum industry's dynamic technology and can offer a valuable technical service to refiners.

CYANAMID

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REFINERY CHEMICALS DEPARTMENT
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NEW! Valuable Information on Sulfuric Acid in this big, fact-packed data book...

36 pages of helpful technical data —including material not available elsewhere!

Here—from America's foremost producer of Sulfuric Acid—is one of the most helpful technical bulletins ever offered on this vital basic chemical. It provides a wealth of carefully selected data which years of consumer contact have proved to be most useful and most frequently required.

In addition to interesting background information, this fact-packed bulletin covers such pertinent topics as physical properties . . . storage and handling methods and equipment . . . methods of analysis, etc. Included are many tables, charts and graphs on Sulfuric Acid and Oleum, some of which are not available elsewhere.

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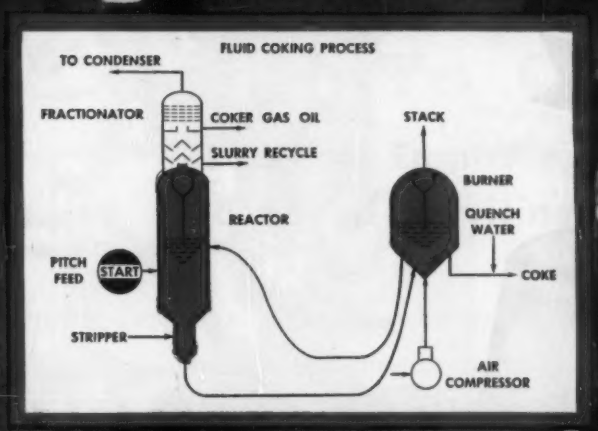

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Esso Research and Engineering Company offers you *Fluid Coking*, the first successful fully continuous process for converting low value pitch into valuable lighter products. *Fluid Coking* actually handles the heaviest feed that can be pumped.

It results in a higher percentage of gas oils, and makes possible greater ultimate yields of good quality heating oil and gasoline, and smaller amounts of coke than any coking process ever developed. *Fluid Coking* is another achievement of the Esso Research program — 38 years of new process developments made available to refiners around the world.

Investment and operating costs are lower. "Fluidized coke" by-product is used as public utility fuel and in the smelting industry; other new and more valuable outlets have been developed.

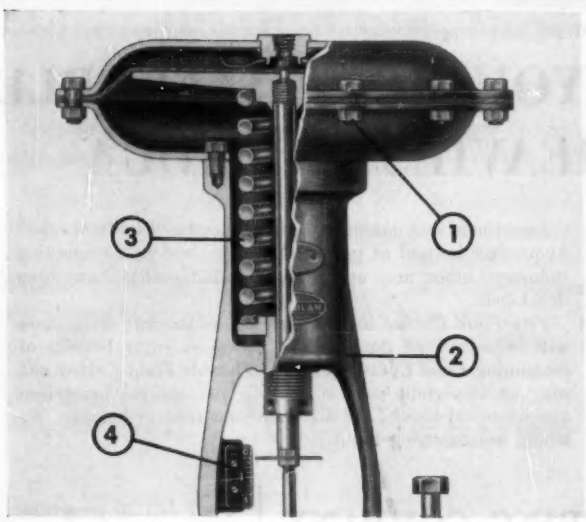
Five *Fluid Coking* installations are on stream; three more will be completed during 1957. Licensees enjoy benefits of continuing *Fluid Coking* research. Flexible *Fluid Coking* can play an important part in helping you process heretofore uneconomical crudes and maintain your refinery balance. We would welcome your inquiry.

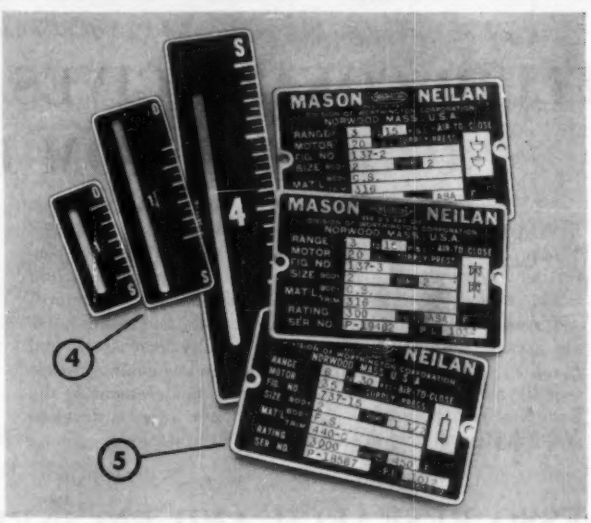
ESSO RESEARCH AND ENGINEERING COMPANY

15 West 51st Street, New York 19, N. Y.

Your key to progress... an Esso Research process

(1) Bolted diaphragm case assures tightness, offers no pockets to accumulate moisture, permits use of flat stock diaphragms in emergency. (2) Cast iron yoke provides inherent rust resistance and rigidity — cannot get out of alignment. (3) Standard 6-30 psi range springs available (at no extra cost) for easy interchangeability with 3-15 psi range. (4) Stroke scale shows actual increments of plug travel. (5) Full specification data on serial plate gives complete information at a glance.





Masoneilan Control Valves Pioneer in

Design To Cut Downtime!

Practical Engineering Builds In Features to Speed Servicing, Reduce Time Losses

Practical engineering aims at reducing maintenance to a minimum and speeding unavoidable servicing. That's one reason Masoneilan Valves find such widespread acceptance — they combine the economies of long life, low service costs and minimum downtime.

Mason-Neilan pioneers many high C_q design features with the *maintenance man* in mind — making his job simpler and more speedily accomplished. Consider, for example, these ten ways in which proper design helps save important money. And for the full story on the complete line ask the office nearest you — or write

MASON-NEILAN
Division of Worthington Corporation
51 NAHATAN STREET, NORWOOD, MASSACHUSETTS

MASONEILAN

Sales Offices or Distributors in the Following Cities: New York • Syracuse Chicago • St. Louis • Tulsa • Philadelphia • Houston • Pittsburgh Atlanta • Cleveland • Cincinnati • Kansas City • Phoenix • Detroit San Francisco • Louisville • Salt Lake City • El Paso • Albuquerque Charlotte • Los Angeles • Corpus Christi • Denver • Appleton Birmingham • New Orleans • Seattle
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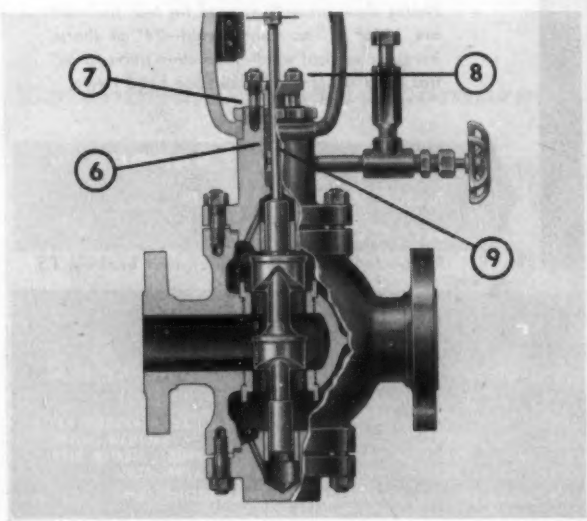
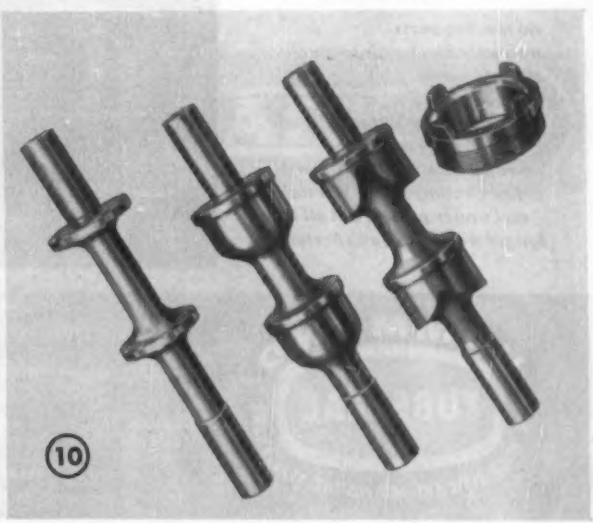
(6) Split-ring, preformed packing assures long service, ease of replacement. (7) Motor is easily removed from bonnet without disturbing packing box. (8) Bolted packing box assures maximum seal with minimum friction; provides visual check on packing life. (9) Superfinished stems move freely, reduce packing box friction, increase packing life. (10) Interchangeability of trim parts assures accurate fit of replacements, speeds conversion for change of process.





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exhaustive tests prove:

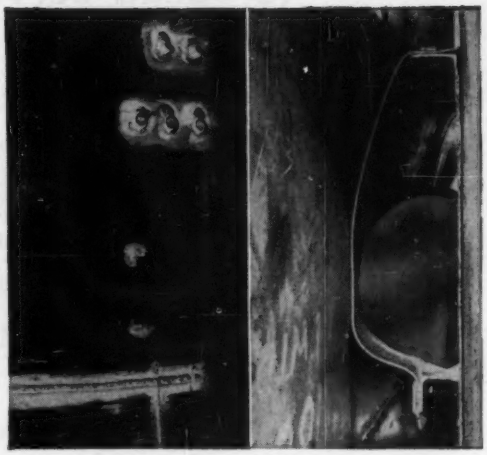
36 YEARS FROM TODAY

TUBESEALS* NOW IN FLOATING ROOF TANKS WILL OPERATE AS EFFICIENTLY AS THEY DO TODAY!

WE DOUBT this can be claimed for any other floating roof seal!

To determine the efficient life-expectancy of the Hammond Tubeseal in service, tests were made under the worst possible conditions to which a floating roof seal can be subjected. The Tubeseal was moved across very rough rivet heads, erection burrs and abrasive weld surfaces, for a total travel of 70,000 feet. This is equivalent to a normal wear of *more than 36 years in actual service.* Moreover, as the tests were run dry, there was the added disadvantage of the absence of lubricating effect normally created by wetted surfaces. Upon completion of these rigorous tests, the scuff band had only worn through the ribs and had barely penetrated through the material, leaving two-thirds of the stock intact; proof that the Tubeseal is unimpaired after traveling 70,000 feet.

The 36 year life-expectancy of a Hammond Tubeseal assumes no mechanical accident and is arrived at in the following manner: Each year a floating roof, in normal service, makes about 48 trips to and from top and bottom of tank. The roof of a 40 foot tank, therefore, will travel 1920 feet per year. Assuming 1920 feet of travel per year (based upon full depth of travel) and applying our accelerated wear test, the Tubeseal will be serviceable for at least 36 years 5½ months.



THE TUBESEAL TEST:

total travel	70,000 feet
travel over vertical weld	46,400 feet (on same line)
Horizontal welded seam crossed	21,200 times
Flat head rivets crossed	63,600 times

CONDITION OF TUBESEAL AFTER TEST: Scuff band had worn through ribs and had barely penetrated into the main material, leaving ⅔ of stock intact.

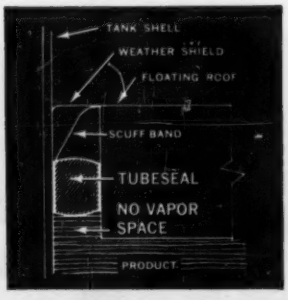
Tests were conducted dry with no aid of lubricant normally resulting from stored product.

Photos show projections used for test. Included are 16" of ⅜" horizontal weld—24" of sharp, irregular vertical weld—2 erection burrs—3 ¾" flat head rivets and 2 ¾" cone head rivets.

THE HAMMOND TUBESEAL
is the most efficient and positive seal known.

it features:

no moving parts
no mechanical maintenance
climate proof
non-corrodible
can operate to bottom of tank or above the top
no vapor space below the seal
entire circumference has tight seal under pressure at all times
longer working life expectancy



NO ROOM FOR VAPORS
NO EVAPORATION
NO CORROSION

**patented* *Write for bulletin TS*

HAMMOND TUBESEAL — THE MOST EFFICIENT AND POSITIVE SEAL KNOWN

HAMMOND IRON WORKS

WARREN and BRISTOL, PA. • PROVO, UTAH • CASPER, WYO. • BIRMINGHAM, ALA.

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Licensees: CALIFORNIA, CANADA, ENGLAND, BELGIUM, GERMANY, ITALY, FRANCE, JAPAN

For more data on advertised products, use Readers' Service Cards, last page.

6,000 horsepower in a single CLARK CBA-8 balanced/opposed compressor

Now, for the really big applications, Clark introduces the most powerful compressor ever built—the new CBA-8. The ability to handle tremendous horsepower, however, is not the only feature of this new compressor. Being extra heavy and rugged in all respects, it is the perfect choice for those services where extremely high pressures are required such as in the process industries and for high pressure wind tunnel applications.

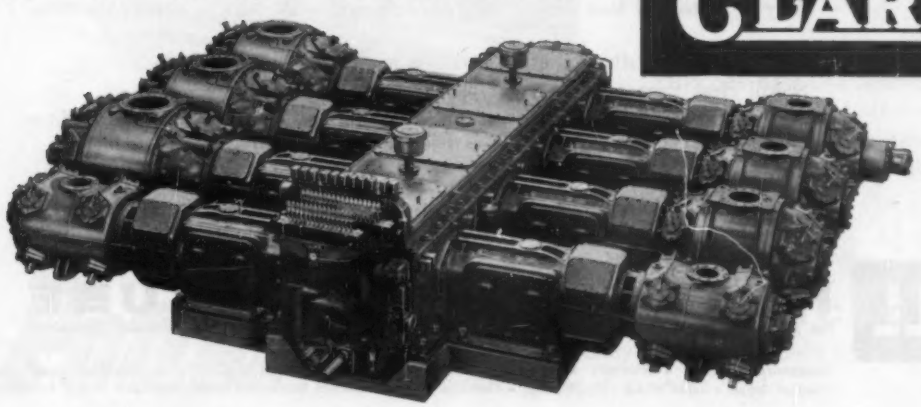
High discharge pressure invariably causes a high pressure rise across the cylinders which results in heavy pin loads. The new CBA-8 is designed to carry pin loads of 100,000 pounds with ease. For large air compressor installations, at normal pressures, the CBA-8 will operate with minimum maintenance because of its heavy construction. The balanced/opposed design principle, originated by Clark, assures vibrationless operation.

Two new CBA-8 units already have been delivered for a special application. Your Clark representative will gladly give you full details on this new unit.

CLARK BROS. CO. · OLEAN, N. Y.
One of the Dresser Industries
Sales offices in Principal Cities Throughout the World

Balanced/Opposed Compressors

CLARK®



For more data on advertised products, use Readers' Service Cards, last page.

. . . there's enough difference to make ALL the difference

At final inspection, each individual Scovill Heat Exchanger Tube is checked for diameter, wall thickness, concentricity and length, to conform to permitted tolerances under pertinent specifications.

Inherent, however, in the quality of the alloys from which these tubes are drawn are many other distinctive "differences." Phosphorized Admiralty Heat Exchanger Tubes, for example, are initially hot extruded from billets made by Scovill's unique continuous casting process. In this process, continuous "blending" of the alloy from many melts produces exceptionally uniform metal . . . with even distribution of optimum inhibitor (phosphorus) content. The net result:—more perfect finished tubes . . . smooth, dense, free from surface defects . . . uniform in chemical composition . . . fully protected for long service life . . . delivered to the user in perfect condition.

On your next installation, let us show you how these "differences" in Scovill Heat Exchanger Tube can lead to superior field performance. A comprehensive range of standard tube alloys is available to meet every condition. Scovill's Technical Service is always ready to help you with special problems.

Scovill Manufacturing Company, Mill Products Division,
99 Mill Street, Waterbury 20, Connecticut. Phone Plaza 4-1171.

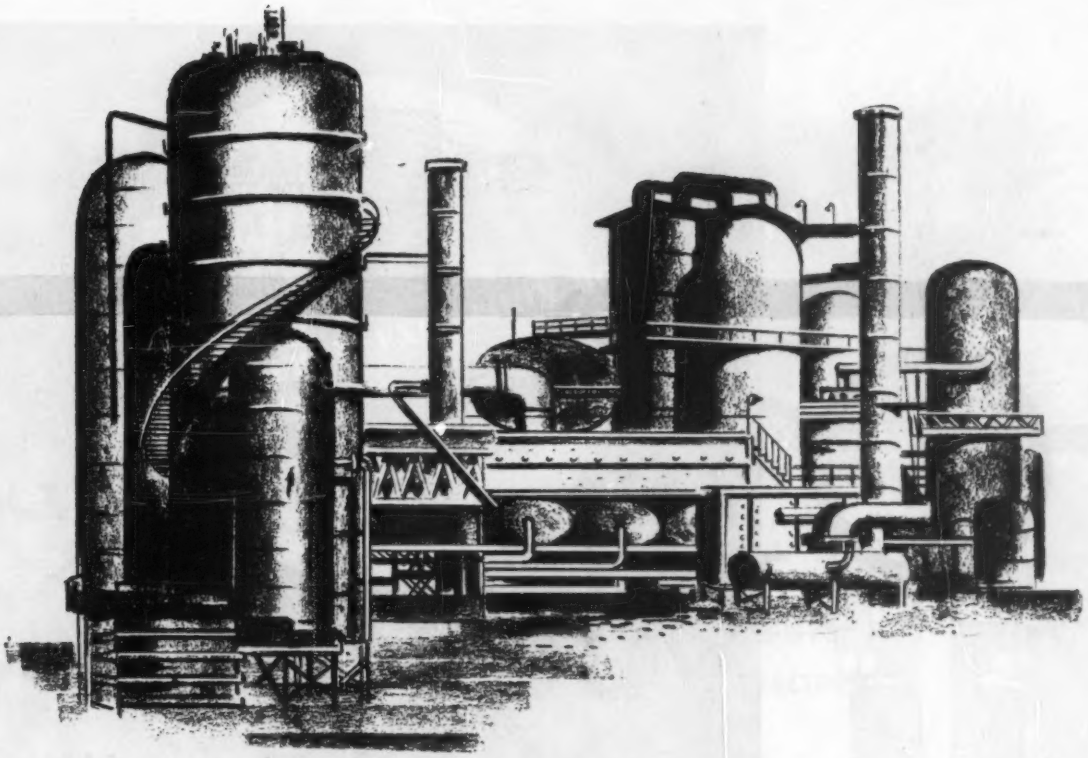
SCOVILL

HEAT EXCHANGER TUBE

FOR APPLICATIONS FROM MARINE TO PETROCHEMICAL . . . FROM COMPRESSOR INTERCOOLERS TO "CAT-CRACKER" EXCHANGERS.

Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Naval Brass • Red Brass, 85% • Deoxidized Copper
Arsenical Copper • Cupro Nickel 10%-20%-30% • Aluminum Brass • Aluminum Bronze, 5% • Muntz Metal • Duplex Tube

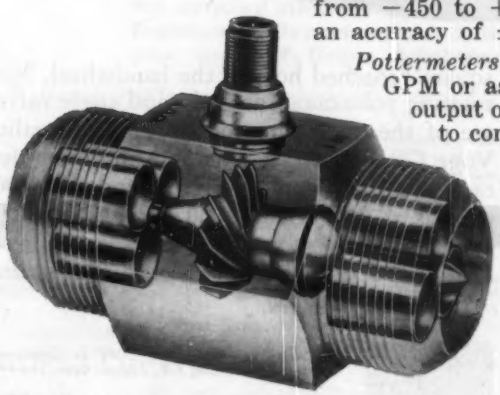
17SC56



FOR VITAL FLOW CONTROL

WHETHER you're developing a new process or modernizing an old one—investigate the unique characteristics of the bearingless *Pottermeter*.

This electronic flowmeter—easily installed in any type of piping to operate at any angle, at any pressure and at temperatures from −450 to +1200°F, measures flow of any liquid with an accuracy of ±½ of 1%.



Pottermeters are available to measure flows as low as 0.07 GPM or as high as 3,000 GPM. The inherently linear output of the *Pottermeter* makes it ideal for systems to control either flow rate or total flow.

Find out how the bearingless "floating rotor" used in the *Pottermeter* can give you more precise flow measurement, longer trouble-free service life, and more accurate flow control.

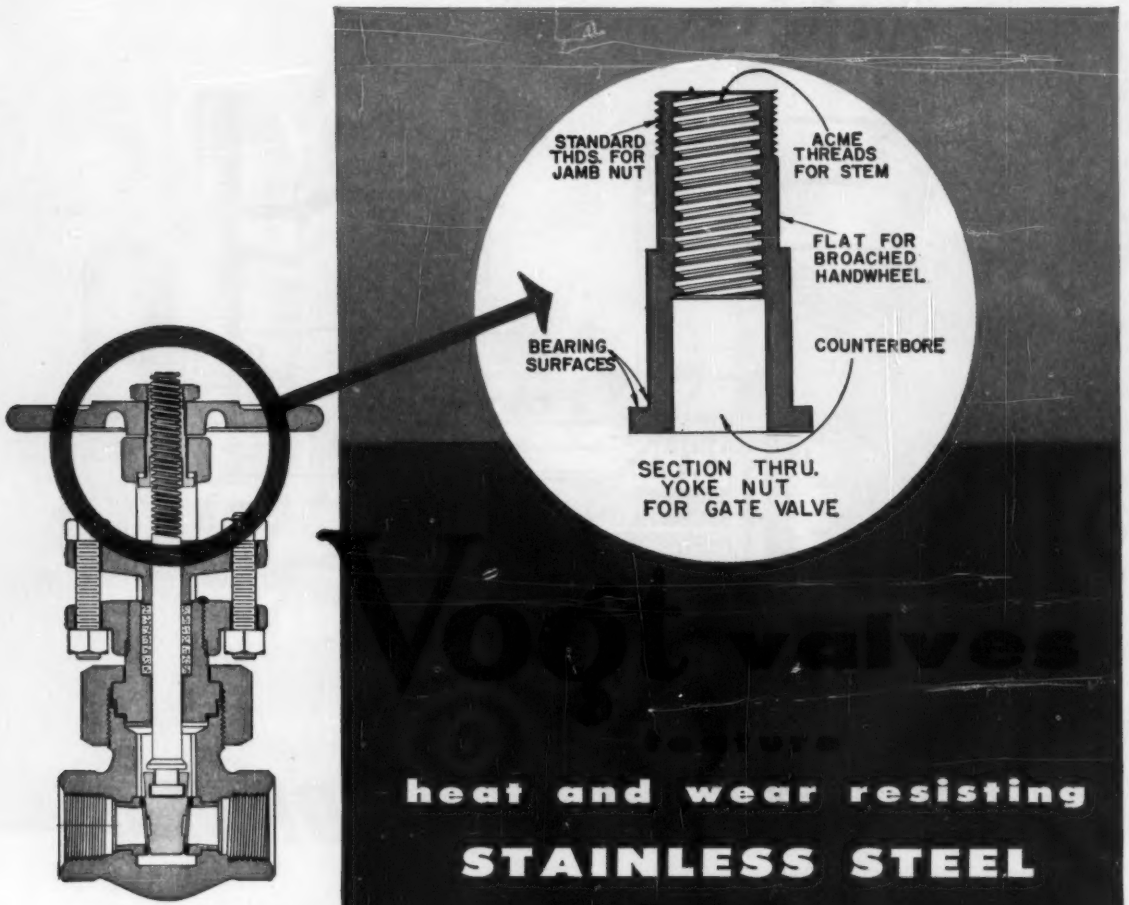
Write for Bulletin PS-1

Potter **POTTER AERONAUTICAL COMPANY**

Route 22 • Union, New Jersey • Phone MUrdock 6-3010

Makers of "Potter Engineered" products

For more data on advertised products, use Readers' Service Cards, last page.



Heat and wear-resisting *stainless steel* yoke nuts in Vogt Valves give longer trouble-free service. We have proved this in our own "Torture Chamber," under constant and accelerated testing, as well as in tough service applications. They are made from a special stainless steel alloy having excellent bearing quality, matchless strength, and a melting point of approximately 2700°F.

The rotating gate valve yoke nut design, illustrated, has flats for a tight fit with the square broached hole of the handwheel. Non-rotating yoke nuts, for globe and angle valves, are of the same superior design and quality. Vogt GP Valves are available in a complete range of sizes from 1/4" to 2" and rated 800 pounds at 850°F. and 2000 pounds at 100°F.

Adv. No. 6 in a series describing the features of Vogt GP Valves.

Write For Your FREE COPY of Supplement No. 1 to Catalog F-9. Address Dept. 24A-FPR.

HENRY VOGT MACHINE CO.
P. O. Box 1918—Louisville 1, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati.

Vogt GENERAL GP PURPOSE Vogt FOR BETTER VALVES

DROP FORGED STEEL

VALVES

For more data on advertised products, use Readers' Service Cards, last page.

RIGHT DOWN OUR ALLEY

A. P. Green castable refractories have been time-tested and proved in the field... for every specific refractory application in the petroleum industry. *Results achieved:* reduced "down time" and labor costs... lower fuel costs and increased heating efficiency... greater safety and reduced maintenance control.

For detailed information and specific recommendations... write, Engineering Department, A. P. Green Fire Brick Company... or call your local A. P. Green distributor.

A. P. Green Castable Refractories... designed to exact specifications to do an exact job

KAST-SET — A rapid setting, high strength refractory castable. Mixed with water, it takes on a hydraulic bond without the application of heat. KAST-SET will not shrink, has excellent resistance to abrasion, and is ideally suited for monolithic linings. It may be used at temperatures up to 2700° F.

KAST-O-LITE — A lightweight castable recommended for temperatures up to 2500° F. It is used for monolithic linings in all types of stills and heaters, tar stills, heat treating furnaces, flues, and stacks. Reduces heat loss. Insures closer temperature distribution and control.

CASTABLE INSULATION NO. 20 — A hydraulic-setting castable for temperatures up to 2000° F. Recommended for complete monolithic linings and lightweight panel construction in oil stills and heaters. Weighs 50 pounds per cubic foot in place.

CASTABLE BLOCK MIX — A hydraulic-setting castable insulation for temperatures up to 1600° F. CASTABLE BLOCK MIX combines the advantages of a castable material with low conductivity and light weight. It provides maximum insulating efficiency and ease of installation. Weighs only 20 pounds per cubic foot in place.

CASTABLES FOR GUN APPLICATION... SK-7 — Gun application of SK-7 produces a lightweight lining with excellent strength and insulating efficiency for temperatures up to 1800° F. Installation and labor costs are reduced... no forms required. Ideal lining for ducts, flues and breechings.

KS-4 — This strong abrasion resistant castable can be gun applied with a minimum of rebound loss. Recommended for catalytic regenerator linings, stack linings, bubble towers, and duct linings exposed to abrasion or corrosion. For temperatures up to 2550° F.

A. P. Green REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK COMPANY

Mexico, Missouri, U.S.A.

Plants: Mexico, Mo. • Woodbridge, N. J. • Sulphur Springs, Texas

IN CANADA: **A. P. GREEN FIRE BRICK COMPANY, LTD.**
Toronto 15, Ontario

DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE WORLD

For more data on advertised products, use Readers' Service Cards, last page.

RIGHT DOWN OUR ALLEY

This is "pipe alley" in a large Midwestern refinery. It is made up of connecting lines between refinery units and storage tanks. Such "pipe alleys" are highly practical to a refinery since all the pipe is confined to one area, and the lines are kept above-ground where they are easily accessible for inspection and maintenance.

Over 70,000 feet of the pipe in this alley is NATIONAL Seamless, "Walls Without Welds," 12¾-inch O.D. with .375-inch wall.

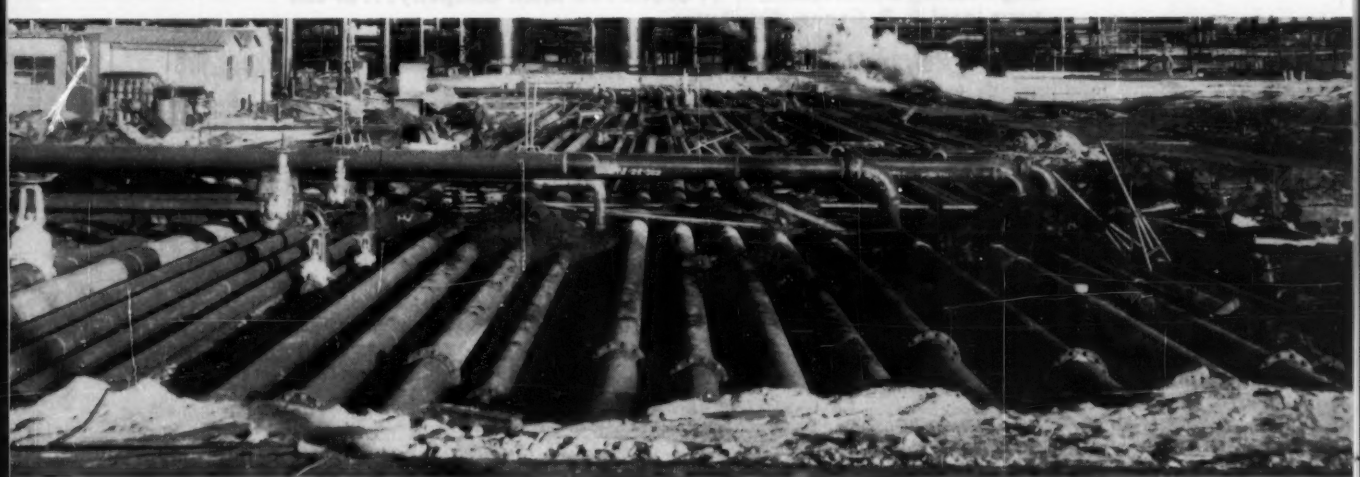
* * *

Refinery pipe and tubing problems are "right down our alley." We manufacture NATIONAL Seamless Pipe and Tubes in over 2 dozen different steel analyses, each designed to counteract specific refinery problems such as corrosion, oxidation, pressure and temperatures. Other chemical compositions are also available in tubular products, and at the present time, a wide variety of high temperature problems is under study.

If you have a refinery tubing problem, we'd like to give you a hand with it. We have a technically trained Mill Service Force available to you for technical and operating assistance in meeting your tubular requirements. This Force is also available for consultation in the field. We'll see that you get the right tubing for the job, at the lowest cost. Write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

TWO DOZEN DIFFERENT NATIONAL TUBE ANALYSES:

Carbon	5 Cr, ½ Mo	17 Cr
Carbon, ½ Mo	5 Cr, ½ Mo, 1½ Si	18-8
1 Cr, ½ Mo	7 Cr, ½ Mo	18-8 Ti
1¼ Cr, ½ Mo	8 Cr, ½ Mo	18-8 Cb
2 Cr, ½ Mo	8 Cr, 1 Mo	18-8 Mo
2¼ Cr, 1 Mo	9 Cr, 1 Mo	25-20
2½ Cr, ½ Mo, ¾ Si	12 Cr	3½ Ni
3 Cr, 1 Mo	12 Cr, Al	5 Ni



NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS **NATIONAL SEAMLESS PIPE AND TUBES** WALLS WITHOUT WELDS

UNITED STATES STEEL

Another move, to serve YOU better . . .

After again outgrowing our quarters, we have purchased property at 108 North Trenton Avenue, in Tulsa, consisting of approximately three and one quarter acres and several buildings. The main office building contains in excess of 14,000 square feet. Our rapidly expanding engineering department will be housed in a separate two story building with about 37,000 square feet. We have our own railroad spur and equipment storage buildings. A paved parking area for about 200 cars permits offstreet parking and should prove a great convenience for both our many visitors and our employees.

You are cordially invited to visit us any time at 108 North Trenton Avenue.

Our telephone (LUther 4-3461) and Post Office Box (1558) numbers remain the same.

TRECo

A DIVISION of VITRO CORPORATION of AMERICA

The REFINERY ENGINEERING Company

NEW YORK TULSA TORONTO

For more data on advertised products, use Readers' Service Cards, last page.

the BUCYRUS ERIE 30-B

Big work output and operating efficiency you can depend on . . . YEAR AFTER YEAR

Here's a brand new 1-yd. profit-maker for you — the Bucyrus-Erie **30-B**. Offered with either crawler or rubber-tired carrier mounting, it's readily convertible to various front ends — shovel, dragshovel, dragline, crane, or clamshell.

New . . . fast . . . quality-built, the **30-B** is just what you need for quick, dependable handling of your refinery maintenance work. Check the brief rundown of features given below; then request full details.

Matched to your needs

- Your choice of diesel, gasoline, or single-motor electric power. Direct or torque converter drive.
- Five easily-converted front ends — shovel, dragshovel, crane, dragline and clamshell.
- Your choice of five crawler mountings *plus* Transit Crane on rubber-tired carrier.
- Extra equipment for special jobs—independent propel, third drum unit, and cathead.

Designed to out-perform

- Easy, air control for smooth, big-output working cycles.
- Easy to service — automatic lubrication of many parts.
- Large, cool-running clutches and brakes.

Built to outlast

- Six conical hook rollers distribute loads evenly between upper and lower works to save wear.
- Five main operating clutches are alike, with parts interchangeable.
- Specially-processed steels add strength and wear resistance.
- Strong, rigid cast revolving frame withstands twisting and bending stresses, maintains machinery alignment.

233E56C

BUCYRUS-ERIE COMPANY
South Milwaukee, Wisconsin

BUCYRUS-ERIE COMPANY
South Milwaukee, Wisconsin

Gentlemen: Please send me details on the new 30-B.

Name _____

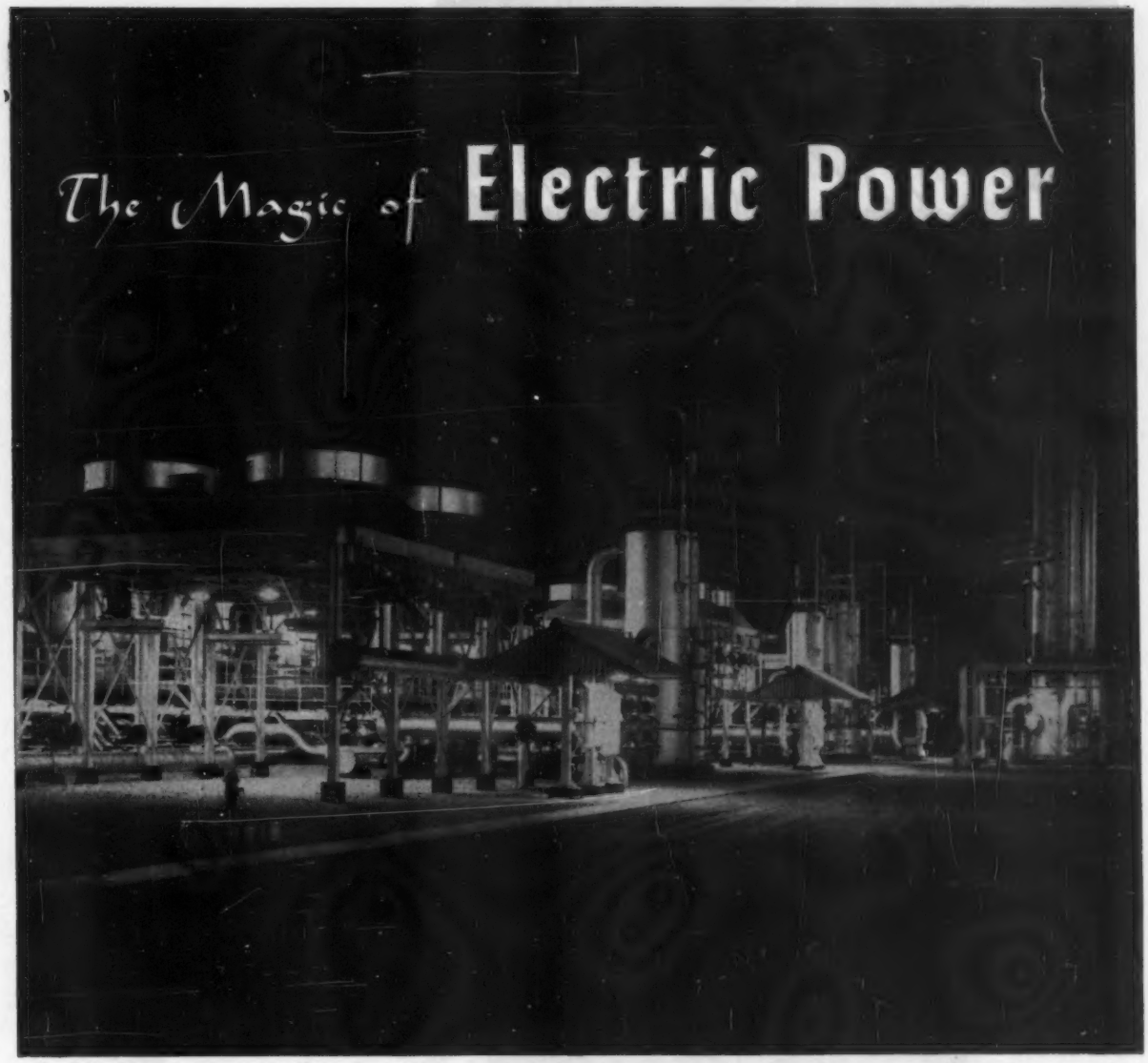
Organization _____

Address _____

City _____ State _____

233E56C

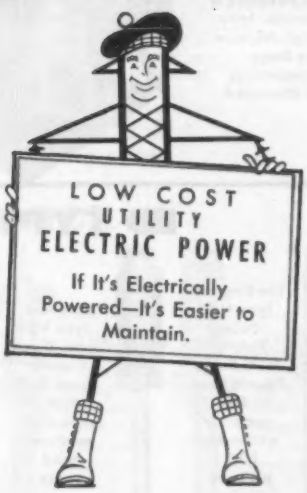
Send for complete facts NOW!



Service... Dependable Service

Next to a captivating sunset nothing has such a magical appearance as a giant refinery flooded by the grandeur of electric light on a pitch dark night.

Spectators view it with unceasing awe — Businessmen view it as a well-lighted, efficiently powered investment. Over 72 per cent of this nation's refineries utilize dependable purchased Electric Power. More cost conscious men are specifying it every year.



WRITE PETROLEUM ELECTRIC POWER ASSOCIATION, P. O. BOX 2771, DALLAS, TEXAS, OR CALL THE SALES ENGINEER OF YOUR LOCAL UTILITY ELECTRIC POWER COMPANY—NOW

For more data on advertised products, use Readers' Service Cards, last page.

Bingham HANDLE AT HIGH

STUFFINGBOXLESS PUMPS

FIREPROOF AND EXPLOSION-PROOF! Leakage of vapor or liquid to atmosphere or leakage from outside into pump is *impossible*. Not only is plant and personnel protected but loss of valuable pumpage is prevented. Type KC High-Pressure Single-Stage Stuffingboxless Pump illustrated.

NO STUFFING BOX! NO PACKING!

Bingham Stuffingboxless Pumps are successfully handling liquids having high vapor pressure, requiring high suction pressure and, frequently, abnormally low pumping temperature (—300° F). Standard models handle suction pressures up to 2,000 psi (higher pressures available). Pumping temperatures to 850° F and higher also can be handled. These conditions present no difficulty for Bingham Stuffingboxless Pumps, but they are difficult and sometimes impossible to meet with conventional pumps due to limitations imposed by the stuffing box.

Because there is *no stuffing box,* Bingham Stuffingboxless Pumps eliminate all the disadvantages of conventional pumps operating with stuffing boxes equipped with packing or mechanical seals.

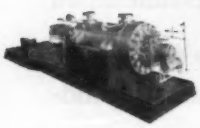
Bingham Stuffingboxless Pumps are in service today all over the world, with distinguished records in reliability, continuity of service, and low maintenance. Write to your nearest Bingham office for Bulletin 107 or for additional information.

***And other volatile liquids.**

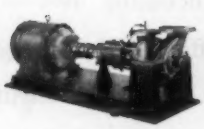
TYPICAL BINGHAM "DOUBLE VOLUTE"

The Bingham Type HPD "Double Volute" Multi-Stage Double Case "Hi-Press" pump for extremely high pressure service.

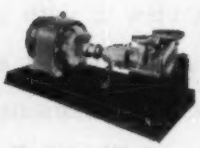
Bingham Type VS Single-Stage Wet-Pit Pump for high capacity, medium head service.



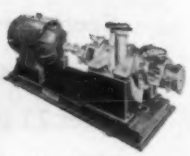
Bingham Type CP "Double Volute" Multi-Stage, Double-Case pump for hot or cold service.



A Bingham Type CKA "Double Volute" Single-Stage Koke-Krusher for coke-laden pumpage.

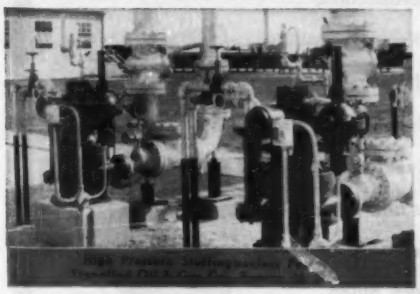


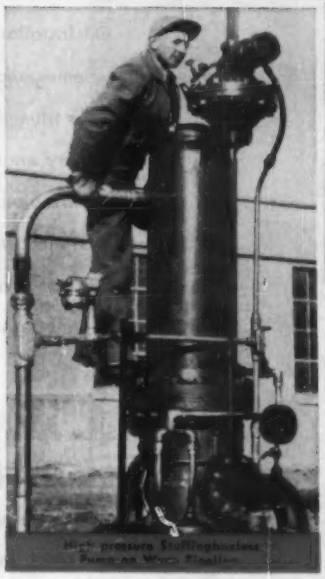
Bingham Type CAD "Double Volute" Single-Stage Process Pump.

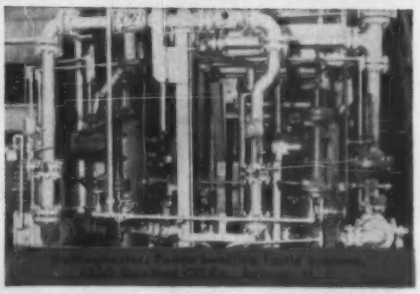


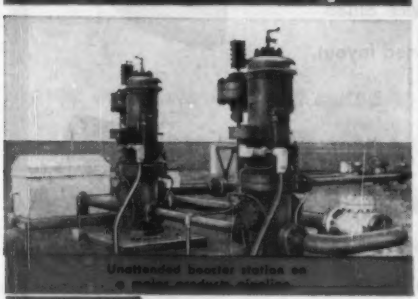
Bingham Type CM vertically split-case two-stage pump for hot service.

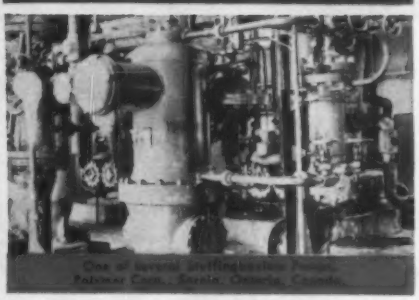
LIGHT HYDROCARBONS* SUCTION PRESSURES








Unattended booster station on a major products pipeline



Partial List of Refineries Using Bingham Stuffingboxless Pumps

British American Oil Co., Ltd.
Carbide & Carbon Chemical Co.
Canadian Investors, Ltd.
Cities Service Company
Creole Pipe Line Company
E. I. duPont de Nemours & Co.
ESSO Standard Oil Co.
Great Lakes Pipe Line Co.
Gulf Oil Corp.
Imperial Oil Company Ltd.
Polymer Corporation
Phillips Petroleum Co.
Stanolind Oil & Gas Co.
Sinclair Oil Company
Sohio Petroleum Co.
Standard Oil Company of Indiana
Tennessee Gas & Transmission Co.
Tide Water Associated Oil Co.
Texas Company
Warren Petroleum Co.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: **2800 N.W. Front Avenue, Portland 10, Oregon**
Factories: **Portland, Ore. • Vancouver, B. C., Canada**

SALES AND SERVICE OFFICES

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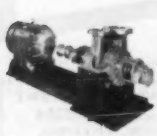
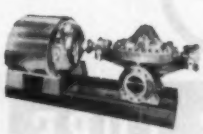
NEW ORLEANS, LA.
NEW YORK CITY, N.Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CALIF.
SEATTLE, WASH.
ST. LOUIS, MO.
ST. PAUL, MINN.
TULSA, OKLA.
TORONTO, ONT., CAN.
VANCOUVER, B. C., CAN.

PUMPS FOR PETROCHEMICAL SERVICE



Bingham Type CD "Double Volute" Double Suction vertically-split case pump for hot service.

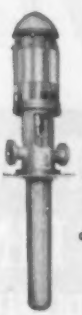
Bingham Type CJ "Double Volute" Two-Stage Process Pump.



Bingham Type HSB "Double Volute" Double Suction Pump for high heads.

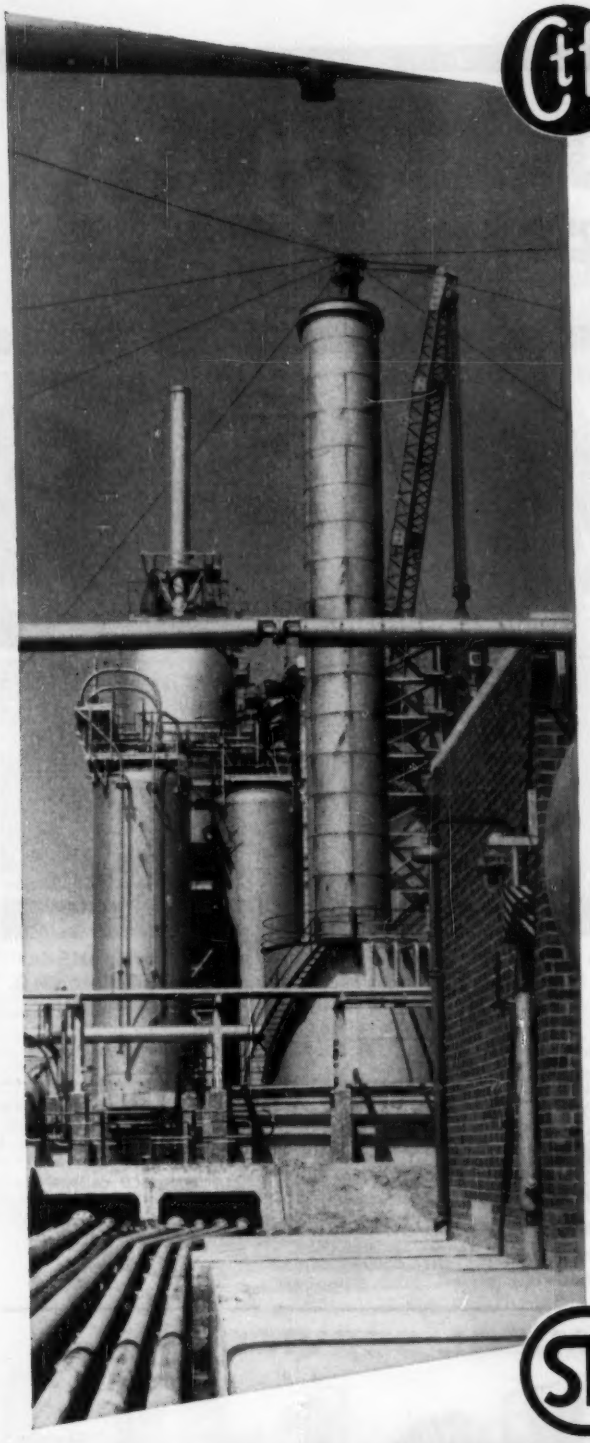
Bingham Type MSB Horizontally Split-Case Multi-Stage Pump for high pressure hot or cold service.

Bingham Type KT Stuffing-boxless Pump for high suction pressures and cold service.



Bingham Type VCP Vertical Pump for low NPSH conditions, featuring bottom dismantling.

For more data on advertised products, use Readers' Service Cards, last page.



Superior plant is the Potent Agent in achieving economical production. Oil Installation schemes and all the other triumphs of twentieth century engineering require pipes and fittings that will give efficient service allied to well planned layout.

Shaw-Petrie and Clyde Tube Forgings Limited, manufacture, fabricate, and erect, to the highest specification, a complete range of pipe-work and Seamless Steel and Alloy Butt Welding Fittings.

SHAW-PETRIE LIMITED

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TELEPHONE TATE GALLERY 9325-6
AND AT SOUTH SHIELDS, LIVERPOOL AND BELFAST

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CLYDE TUBE FORGINGS OF AMERICA
PORTLAND OREGON U.S.A.

Refinery Insulation

All CAPOSITE moulded insulation materials are made of Amosite asbestos. The photograph clearly demonstrates the immense volume which is obtained when the natural Amosite is fiberised—the sign of high efficiency as an insulating medium.

CAPOSITE is supremely well suited to the thermal insulation of oil refineries. With a limiting temperature of 1000°F., high thermal efficiency and great structural strength and resilience, CAPOSITE has gained for itself a unique position among thermal insulation materials used by the Oil Industry.

CAPOSITE MOULDED ASBESTOS FIBRE PIPE INSULATION

EFFICIENCY DATA SHEET—PIPE SIZES 6" to 10" BORE.

HOT FACE TEMPERATURE °F.			400°F			600°F			800°F		
THERMAL CONDUCTIVITY K = B.Th.U. in./sq. ft./hr./in./°F.			0.43			0.47			0.53		
MEAN TEMPERATURE °F.			250			350			450		
Nominal Pipe Size	O.D. pipe	Thickness of Insulation	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.
6"	6¼"	1"	135	87·7	126	233	90·6	167	354	92·5	218
		1½"	102	90·8	107	177	92·9	135	270	94·3	171
		2"	83·6	92·4	97	145	94·1	118	223	95·3	145
		2½"	71·8	93·5	91	125	95·0	107	192	96·0	128
		3"	63·5	94·2	86	110	95·5	100	170	96·4	117
		3½"	57·3	94·8	83	100	96·0	95	154	96·7	109
		4"	52·6	95·2	81	91·7	96·3	91	142	97·0	103
8"	8⅝"	1"	130	88·0	127	225	90·8	169	341	92·7	222
		1½"	97·7	91·0	108	169	93·1	137	258	94·5	174
		2"	79·2	92·7	98	138	94·4	120	211	95·5	148
		2½"	67·4	93·8	92	117	95·2	109	180	96·1	131
		3"	59·2	94·6	87	103	95·8	102	159	96·6	120
		3½"	53·2	95·1	84	92·7	96·2	96	143	96·9	111
		4"	48·5	95·6	82	84·6	96·5	92	131	97·2	105

These figures are compiled from results of official tests by THE NATIONAL PHYSICAL LABORATORY, TEDDINGTON, computed in accordance with formulae shown in BRITISH STANDARD SPECIFICATION appendices.

Please write for full technical details

THE CAPE ASBESTOS COMPANY LIMITED
114 & 116 Park Street, London, W.1.
Cables: Incorrupt, London.

CAPOSITE REGD
Amosite Asbestos Blocks and Pipe Sections

Enquiries in CANADA to: Cape Asbestos (Canada) Ltd., 200 Bloor Street East, Toronto, Ont.
U.S.A.: The North American Asbestos Corporation, 141 West Jackson Boulevard, Chicago, 4, Illinois.
SOUTH AFRICA: Cape Asbestos South Africa (Pty.) Ltd., P.O. Box 2533, Johannesburg; ITALY: Capamianto S.P.A., via Sant' Antonino 57, Turin.
FRANCE: Isolamiante S.A. 37 Avenue Franklin D. Roosevelt, Paris 8e.

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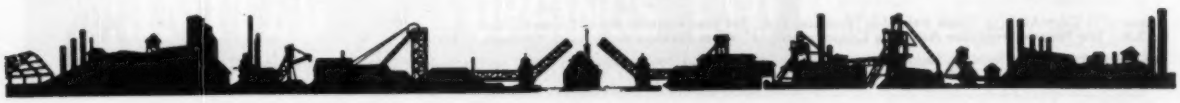
The Personnel Manager, Dept. P.

HEAD WRIGHTSON & CO. LTD.

TEESDALE IRON WORKS, THORNABY-ON-TEES



ON COVERING THE WORLD . . .

A 50 YEAR EXPERIENCE

From the early days of "Boiler Covering" Newalls have been foremost in the development of industrial insulation techniques.

In almost every country, meeting all types of climatic and working conditions, are installations on which Newalls' Insulation has for many years given maximum heat conservation and temperature control.

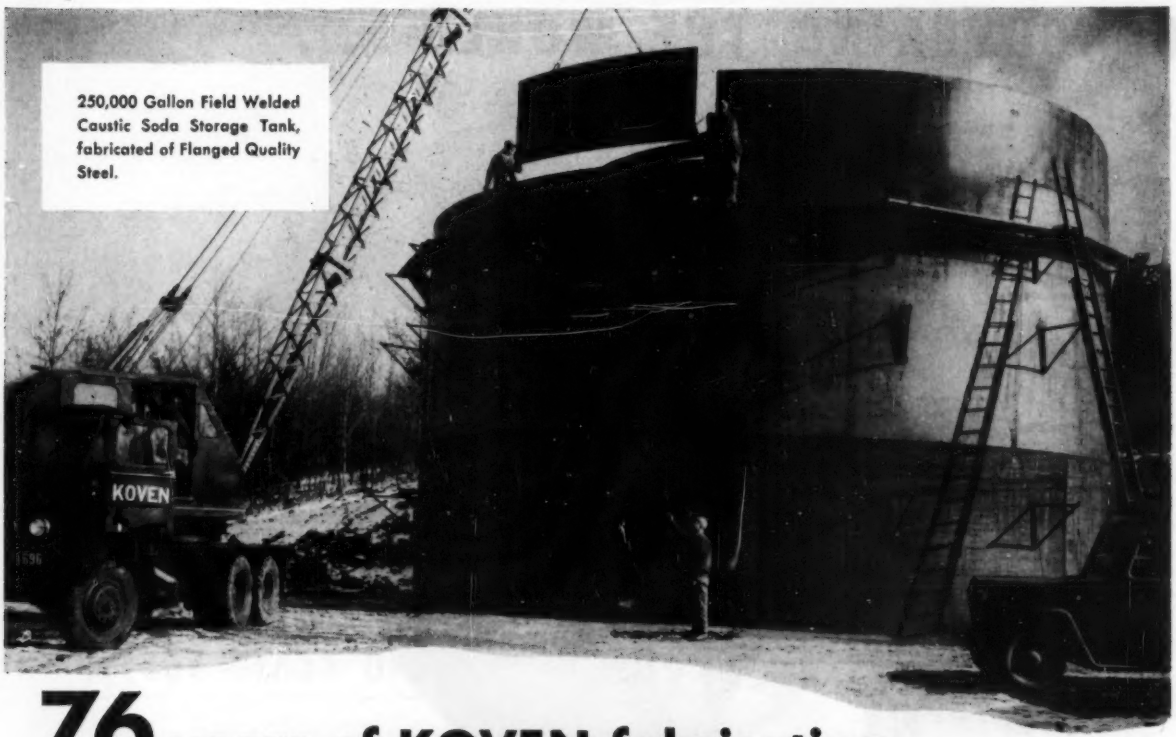
With an international contracting organisation and time-proved materials including Newalls (Reg'd. Brand) 85% Magnesia, Nicosil, Newtempheit and Amosite Asbestos, Newalls provide an insulation service ensuring peak operating efficiency in Oil Refineries and Petro-Chemical plants.

Newalls
(REG'D BRAND)

LEADERS IN REFINERY INSULATION

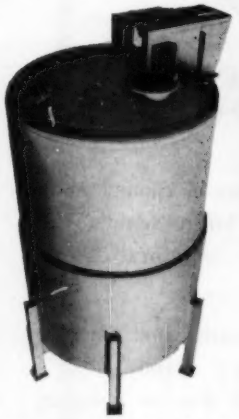
NEWALLS INSULATION CO. LTD. *Head Office:* WASHINGTON, CO. DURHAM, ENGLAND
A member of the TURNER & NEWALL ORGANISATION
Agents and vendors in most markets abroad

For more data on advertised products, use Readers' Service Cards, last page.

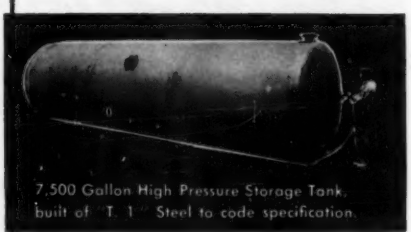


250,000 Gallon Field Welded Caustic Soda Storage Tank, fabricated of Flanged Quality Steel.

76 years of KOVEN fabricating *Experience* built into every job



10' diameter x 20' high, Stainless Steel Jacketed Digester, built for 250 lb. working pressure. All seams 100% X-rayed.



7,500 Gallon High Pressure Storage Tank, built of T. 1 Steel to code specification.

X-RAY INSPECTION FOR QUALITY CONTROL

KOVEN equipment in all metals and alloys includes: High pressure vessels built to A.S.M.E., A.P.I. Codes; extractors; mixers; stills; kettles; tanks; stacks; breechings; hot transfer lines; large diameter fabricated piping and plate exhaust ducts; shop and field erected storage tanks; high vacuum testing.

SPECIALISTS IN INTRICATE FABRICATION USING:

- STAINLESS STEEL • ALUMINUM
- MONEL • NICKEL • INCONEL
- ALL CLAD MATERIALS
- NICKEL PLATED STEEL

Fabrication to all A.S.M.E. Codes

Nickel Plated Steel Fractionating Columns for use with Alkali Processing; 4' diameter x 40' long.

Call or write for a consultation with a trained KOVEN representative, and send for Bulletin #550.

See Sweet's Catalog File and Chemical Engineering File

Koven

KOVEN FABRICATORS, INC.
92 E. Dickerson St., Dover, New Jersey
Telephone: FOxcroft 6-0400
PLANTS: JERSEY CITY, N. J. • DOVER, N. J. • TRENTON, N. J.

how much does heater downtime cost?

A 36,000 B/D petroleum refining unit using a 100 million Btu heater upgrades the value of its crude charge roughly $25,000 per stream day. If the heater comes down for any reason only 10 days a year, a loss of a quarter million dollars is chalked up. A gain of 30 operating days in the year can mean a realization of 10% on capital investment which, in a multi-million dollar plant, is a considerable sum.

Downtime is expensive. The purchaser of a heater must as a result look beyond his initial cost to the long pull. For the long pull, Lummus oil heaters have consistently exhibited great durability while operating efficiently and with an absolute minimum of days lost to maintenance work.

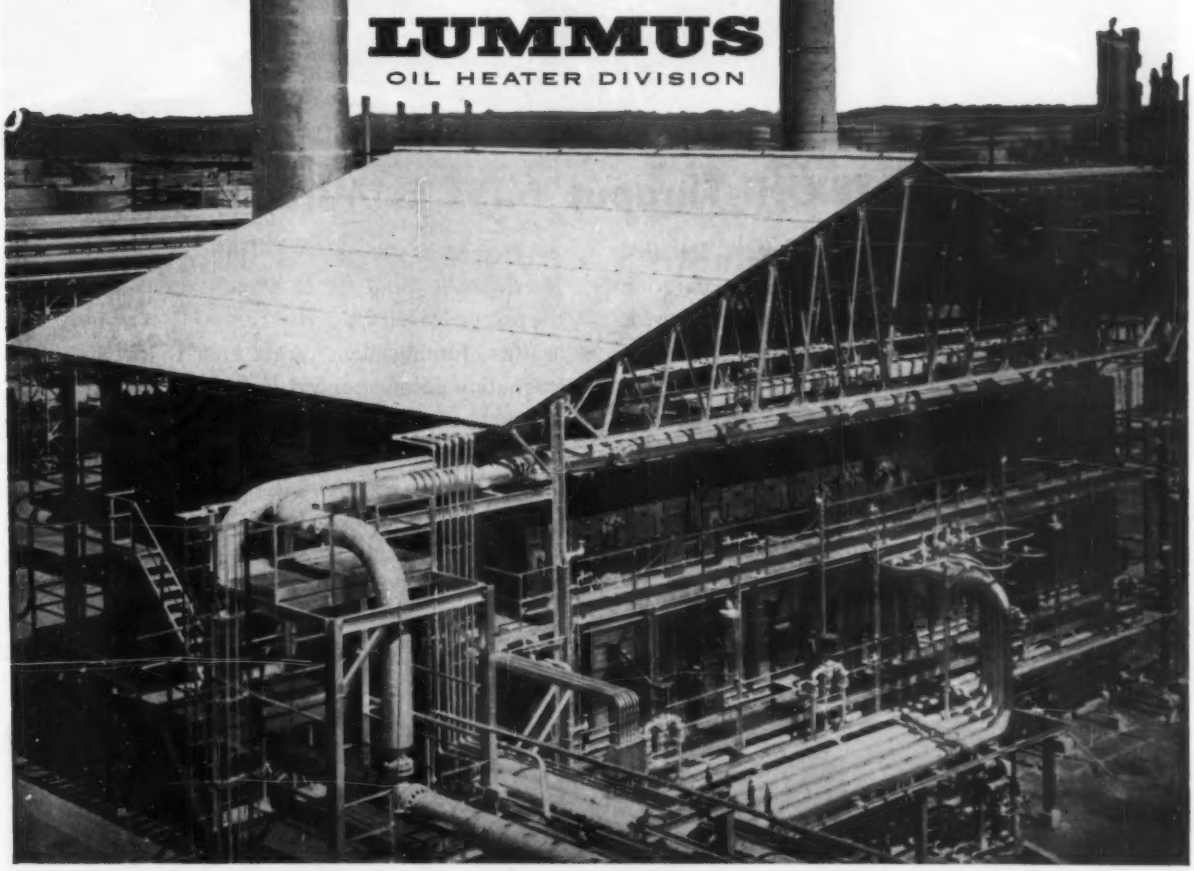
The major refiners prefer Lummus heaters for this reason. In the last 25 years, the dollar value of Lummus furnaces purchased has exceeded that of any other company in the world. So—when you consider a new refinery or a new unit—assure good operation and maximum profit throughout the life of your plant.

Consult with us on design, engineering and construction of your heater installation.

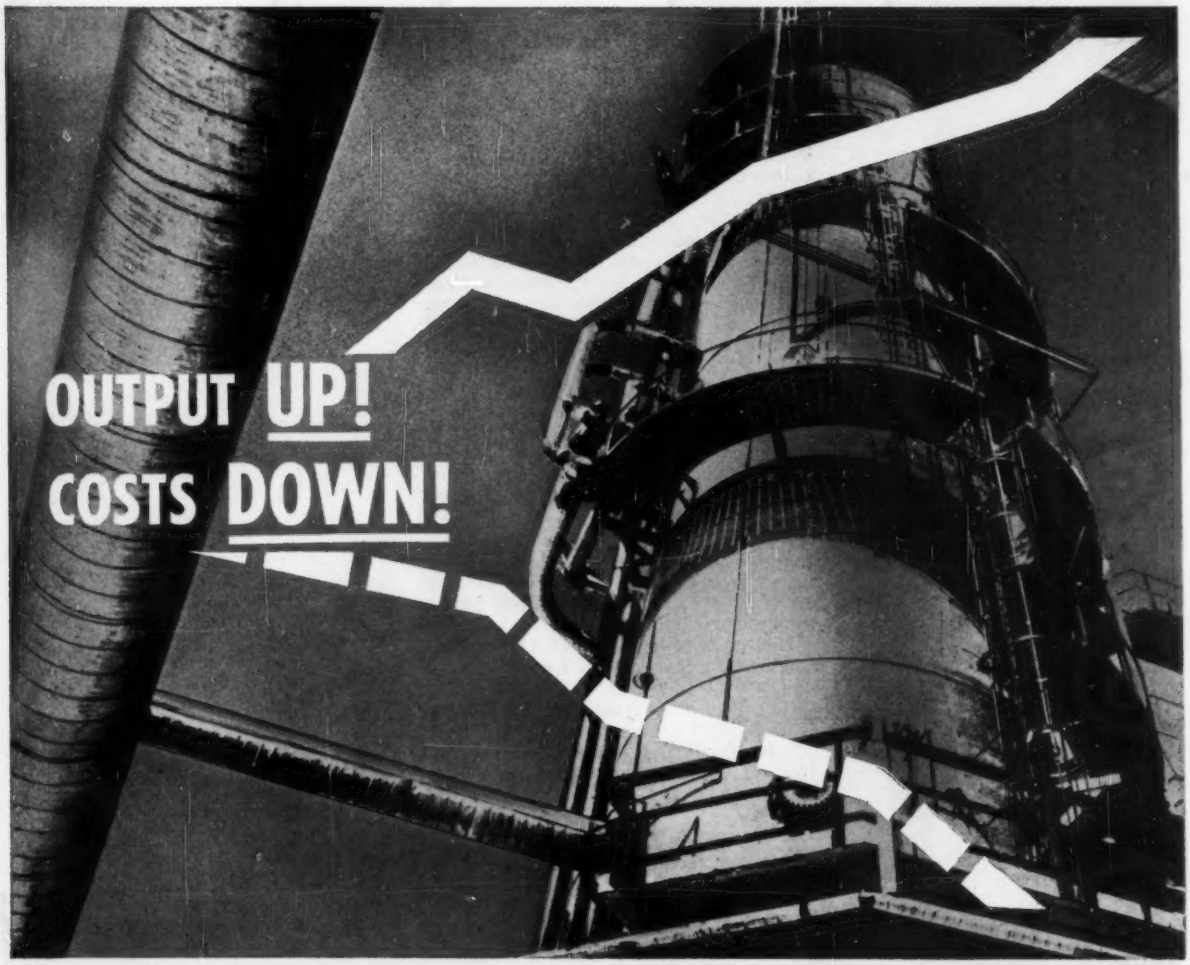
The Lummus Company, Oil Heater Division, 385 Madison Avenue, New York 17, N. Y. Branch offices in Chicago, Houston, Montreal, London, Paris, The Hague, Caracas.

LUMMUS

OIL HEATER DIVISION



For more data on advertised products, use Readers' Service Cards, last page.



with METEX Hi-Thruput MIST ELIMINATORS

METEX Hi-Thruput Mist Eliminators, installed in process towers and vessels, effect sharp separation of liquids and gases. Quality and yield are increased. Valuable liquids are knocked out and returned. Contamination of subsequent processing is removed. Turbines and compressors are protected from damaging liquids. Where build-up of coke or solids is a consideration, on-stream service life is increased three to four times. Air pollution is reduced, too.

METEX Hi-Thruput Mist Eliminators provide virtually 100% removal efficiency, even at extreme temperatures and pressures. Pressure drop is negligible. Their outstanding performance is due to repositioning of the wires by the METEX patented Herringbone Fold . . . an exclusive development of the originators of knitted wire mesh entrainment separators. Impingement target area is increased and stagnation points reduced.

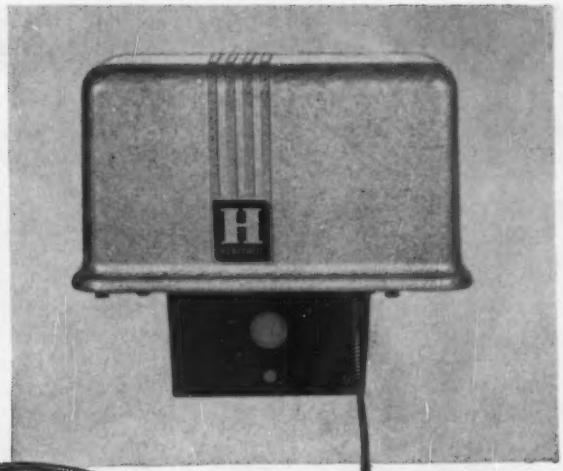
In any processing equipment or vessels where liquid entrainment is a contributing factor in design or operation, specify METEX Hi-Thruput Mist Eliminators to assure greater production, improved quality of yield and substantially reduced operating and maintenance costs.

For complete information and specifications, write today for your free copy of Bulletin No. ME-6.

6-201

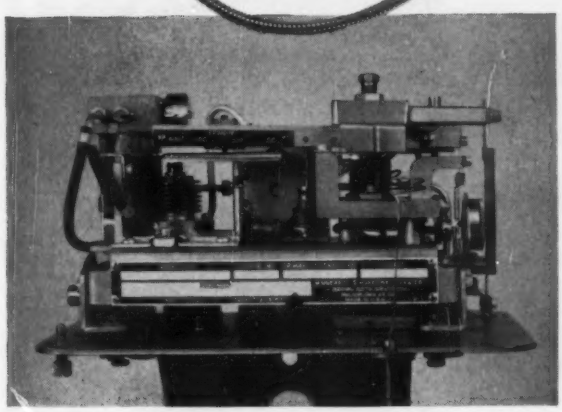
METAL TEXTILE CORPORATION ROSELLE, NEW JERSEY

Metal Textile Corp. of Canada, Ltd., Hamilton, Ontario • Representatives in principal cities throughout the world



You can mount the transmitter at the point of measurement, either indoors or out. A sturdy, weatherproof aluminum cover protects all working parts and adjustments.

Interior view of the transmitter shows the accessibility of all parts. Span and zero adjustments are easy to make, and no changes of parts are required.



only the TEL-O-SET transmitter

gives you full rangeability without changing parts

THE *Tel-O-Set* transmitter offers complete versatility. This highly accurate force-balance instrument measures temperature, gage pressure or absolute pressure, and transmits a proportionate output signal to a receiver or controller. It requires only one thermal system and one pressure system for all ranges, and changeover from temperature to pressure measurement is extremely simple.

You can adjust the span to any values between 20 and 150 psi, or 50 F and 400 F. And you can shift the span to cover any part of the overall transmitter range . . . from 40 to 600 psi, or from —375 to 1000 F . . . *without changing parts.*

The *Tel-O-Set* transmitter is unmatched in performance. It's just as accurate at small spans of 20 psi and 50 F as at wide spans of 150 psi and 400 F. It responds swiftly to changes in temperature or pressure to give you control within close tolerances. It's effectively compensated for ambient temperature and pressure, and fully protected against the effects of vibration.

Get complete details on *Tel-O-Set* transmitters . . . and related *Tel-O-Set* miniature indicators, recorders and controllers . . . from your nearby Honeywell sales engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA: Write for Specification S1003-1.**

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

SERVING THE
PETROLEUM
NATURAL GAS
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HOUSTON, TEXAS

CONSULTATION, PROCESS AND DEVELOPMENT ENGINEERING, SURVEYS AND ECONOMIC STUDIES ARE A PART OF OUR BROAD ENGINEERING SCOPE.

DETERMINATION OF THE REQUIREMENTS FOR RAW MATERIALS, UTILITIES AND PLANT INVESTMENT PLUS AN EXTENDED FORECAST OF EARNINGS WHICH PROPERLY RELATES THESE ITEMS IS NECESSARY FOR A REALISTIC RE-EVALUATION OF YOUR INTEREST IN ANY PROCESS.

HASTELLOY Alloys in Convenient Forms

Trade-Mark

...for Superior Corrosion Resistance

EXTRA CORROSION RESISTANCE

Equipment made of HASTELLOY alloys is giving good service handling such severe corrosives as boiling hydrochloric and sulphuric acids. The alloys are also used to handle these acids at lower temperatures and in all concentrations. HASTELLOY alloys are the most economical material for handling such reactive materials as hydrogen fluoride and wet hydrogen chloride gas at high temperatures. The alloys are also highly resistant to wet chlorine, acid salts, phosphoric acid, nitric acid, and organic acids.

AVAILABLE IN STANDARD FORMS

HASTELLOY alloys are available in all of the standard mill forms—sheet, plate, bars, rods, wire, tubing, pipe, fittings, and fasteners. They can be obtained as sand and investment castings.

TEST THEM NOW

Samples for trying HASTELLOY alloys under actual plant conditions are available without charge. Get in touch with the nearest Haynes Stellite Company office and describe the corrosive conditions involved.

HAYNES STELLITE COMPANY

A Division of Union Carbide and Carbon Corporation

UCC

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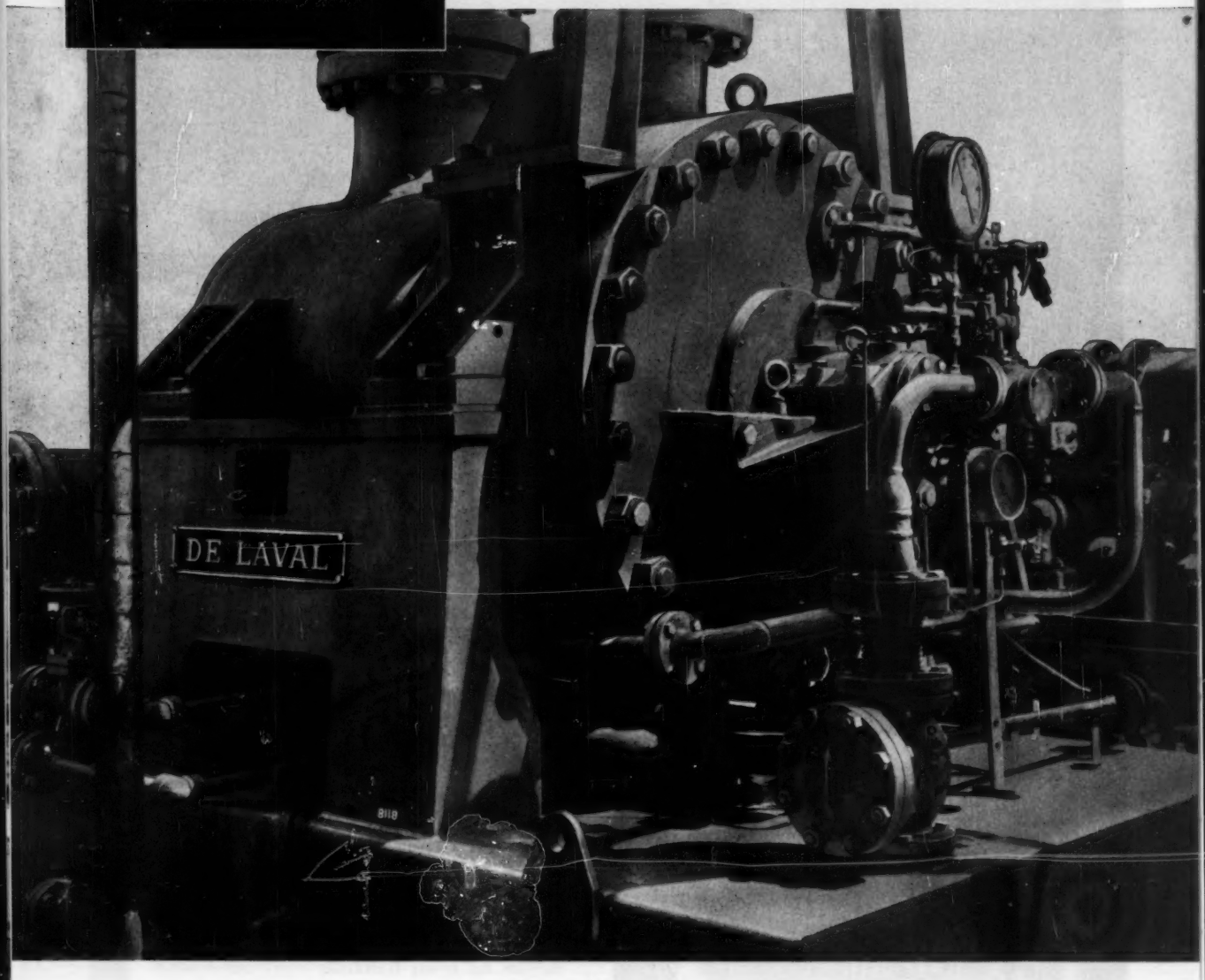
DE LAVAL

BARREL TYPE REFINERY COMPRESSOR

handles hydrogen under high pressures in a reformer at General Petroleum



Send for new Bulletin 0504

This De Laval centrifugal recycle barrel type compressor is doing a dependable job handling hydrogen under high pressures at the General Petroleum plant in Ferndale, Washington. It takes hydrogen at an inlet pressure of 500 psig and discharges it at 625 psig. The unit is driven by a 1110 hp turbine operating at 9900 rpm.

General Petroleum Corporation is only one of many refiners who have specified De Laval Compressors. Whether you need to handle light or heavy gases at high or low pressures in catalytic cracking, reforming, alkylation, coking or any similar service, it pays to look to De Laval. Rugged De Laval centrifugal compressors perform dependably in heavy-duty continuous operation. De Laval has more than 40 years of experience in solving gas compression problems.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY

811 Nottingham Way, Trenton 2, New Jersey

DL-367

Puzzled about getting the Right Explosion-Proof Lighting Equipment?

Only Crouse-Hinds has everything you need

...in every class ...in every group!

For *complete* protection when making lighting installations in hazardous locations you need more than explosion-proof or dust-tight lighting fixtures. You also need UL-listed explosion-proof switches, junctions, fixture supports, unions and seals.

Crouse-Hinds now offers a broad selection of Condulet* explosion-proof lighting equipment for Class I, Groups A and B locations. In fact, you can specify complete Crouse-Hinds explosion-proof lighting installations, all UL-listed, *no matter what class or group of Article 500 of the National Electrical Code is involved.*

The same holds true for the entire Crouse-Hinds Condulet line of more than 15,000 conventional and explosion-proof items. With the broadest line in the field, Crouse-Hinds recommends *exactly* what you need . . . and *only* what you need.

A nearby Crouse-Hinds distributor will be glad to discuss your explosion-proofing problems and make recommendations without obligation.

NATIONAL ELECTRICAL Week
FEB. 10-16, 1957

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*Registered Trade-Mark

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9 ways to demineralize water

(BY ION EXCHANGE)

KEY:

- Hydrogen Cation Unit — Removes metallic cations such as calcium, magnesium, sodium. Regenerated with sodium for simple water softening.
- Weakly Basic Anion Unit — Removes strongly ionized acids such as sulfuric, hydrochloric, nitric.
- Strongly Basic Anion Unit — Removes strongly ionized acids, also weakly ionized acids such as silicic and carbonic.
- Mixed Bed Unit — Contains both Hydrogen Cation and Strongly Basic Anion Exchangers, intimately mixed.
- Degasifier — Optional. Reduces load on Strongly Basic Anion Exchanger by removing free CO_2 brought in by raw water or developed in cation unit.

A	Effluent Conductivity—10 to 20 micromhos (no silica reduction)	Uses low-cost anion exchanger and anion regenerant (soda ash). Typical use—removing soluble salts from water for ceramic mixes and slips or from rinse waters used before painting, mirror silvering, etc.
B	Effluent Conductivity—same as A. Silica content—0.02 to 0.15 ppm.	Used for treating feedwater for boilers in general range of 600 to 1400 psi. Also (without degasifier) for removing impurities from plating baths and recovering chromate from plating rinses.
C	Same effluent as B.	For raw water with high sulfate and chloride content. Low-cost Weakly Basic Anion Exchanger removes major portion of electrolyte load. Countercurrent regeneration of anion units reduces operating costs.
D	Effluent Conductivity—3 to 5 micromhos. Silica same as B.	For same type of raw water as C. Countercurrent regeneration of both cation and anion units cuts operation costs.
E	Effluent Conductivity—1 to 5 micromhos. Silica same as B.	For waters where alkalinity is a major part of the anion content. Polishing units require infrequent regeneration. Produces, at low cost, low-solids feedwater suitable for high pressure boilers (over 1400 psi).
F	Same effluent as E.	High flexibility of operation. Can operate in parallel for peak flows. Can maintain service flow during regeneration of either pair of units.
G	Effluent Conductivity—less than 1 micromho. Silica same as B.	Produces effluent of extremely high quality. Suitable for "super critical" pressure boilers and atomic reactors. (Initial and operating costs are usually higher than for separate anion and cation units.)
H	Same effluent as G.	For raw water with high sulfate and chloride content. Two-step demineralizer reduces load on Mixed Bed unit, cuts operating cost. (Strongly Basic Anion Exchanger is used in place of Weakly Basic where raw water has high silica and alkalinity.)
I	Same effluent as B.	Recommended where alkalinity of raw water is high. Cation unit and Degasifier reduce load on Mixed Bed unit, cut operating costs.

All of the above systems, with equipment and resins made by Permutit, are in commercial use. Other combinations are possible—also use of special ion exchangers such as PERMUTIT SK for separating uranium oxide from other metallic oxides in ore.

Most of these systems (C and higher) are used almost exclusively for demineralizing feedwater for high-pressure boilers . . . but the list of possible applications in other fields is growing.

If you have a problem ion exchange might solve, we'll be glad to study it with you and bring you the benefits of this experience. Address: The Permutit Company, Dept. PR-1, 330 West 42nd St., New York 36, N. Y.

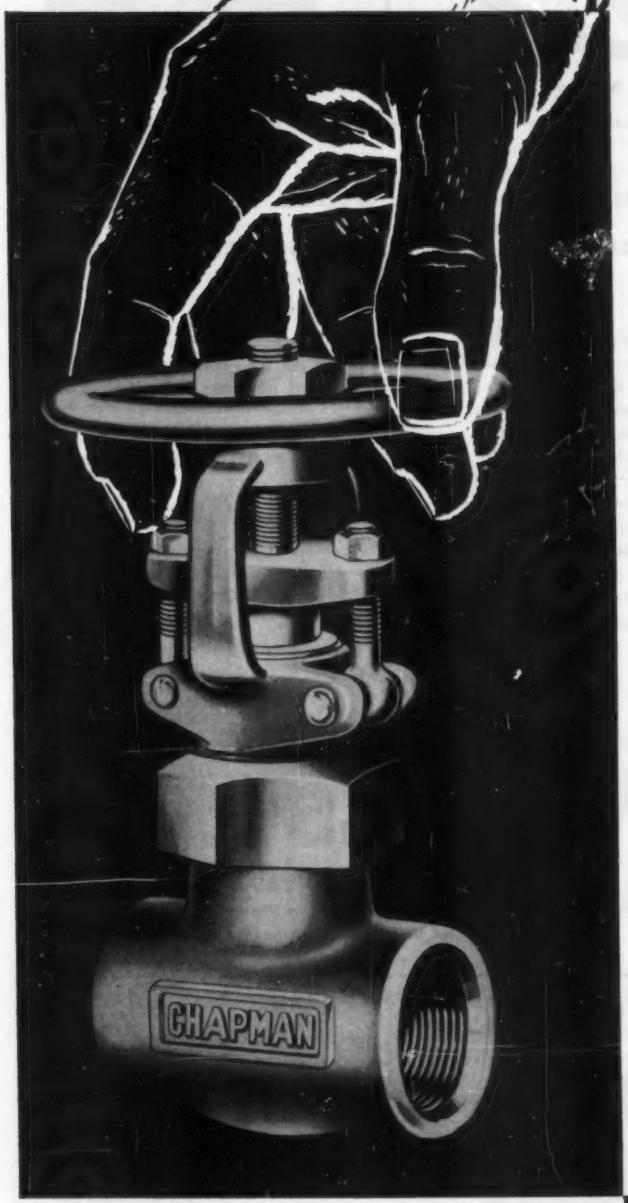
PERMUTIT®

rhymes with "compute it"

ION EXCHANGE for Water Conditioning
Chemical Processing • Industrial Waste Treatment

For more data on advertised products, use Readers' Service Cards, last page.

TURN ON PERFORMANCE
...Turn off your Costs!



CHAPMAN LIST 960
Forged Steel Gate Valves

This is an open and shut case of top performance and lowest maintenance. To begin with, the wedge faces on Chapman List 960 are *super* hard. In fact, they're hardened to 800 Brinell by Chapman's *exclusive Malcomizing process.* They can't seize. They can't gall. The seat rings are hardened stainless steel. They last longer and, when necessary, they're very easy to replace.

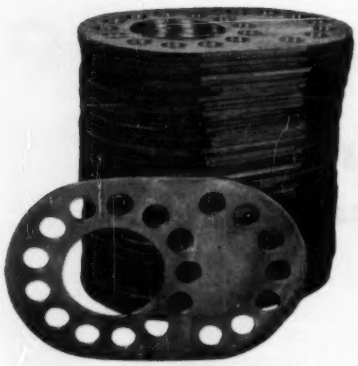
There are no full-pressure repacking difficulties. Bolted follower on the outside screw rising stem design has no threads that are exposed.

Is it any wonder there are more Chapman List 960 valves on more jobs than any other small forged steel gate valve? They stand up perfectly under conditions ranging from 380 psi at 1000°F to 2000 psi at 100°F. You use Chapman List 990 valves for higher pressures. Sizes for List 960 are from ¼″ to 2″. You can have rising stem with yoke or rising stem with inside screw. And the Bonnet joint is either gasketed or ground metal-to-metal, depending upon your needs.

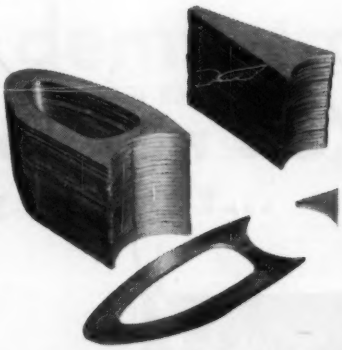
To take a good look at the ways to cut your valve costs, take a good look at our Catalog 10. Write, today, for your copy.

The CHAPMAN VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASS.

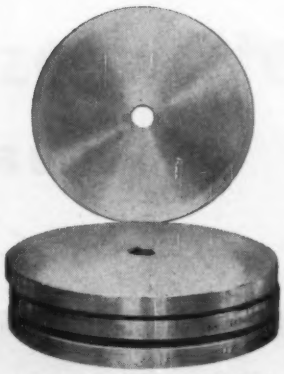
For more data on advertised products, use Readers' Service Cards, last page.



Blank size: ⅜" thick x 16½" x 23½"

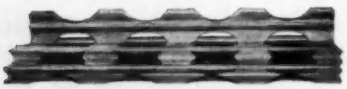


Blank size: ⅜" thick x 9" x 31"



Blank size: 5" thick x 78" OD

Blank size: 4" thick x 7¾" x 71⅜".
Illustrations show before and after machining.



All the products illustrated here were flame cut, sawed, abrasive cut, sheared or machined from stainless steel plate.

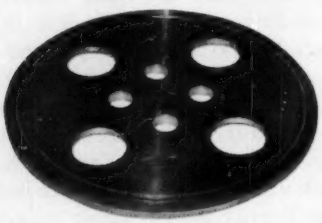
Stainless steel plate produced to your specifications for quick delivery

Confidence in Carlson service has made G. O. Carlson, Inc. the country's leading specialist in stainless steel plate. As we grew to this position in the industry, we learned and developed new methods of working stainless plate.

What does this mean to you?

It means you can buy for quick delivery exactly what you need in stainless steel plate—sheared, sawed, flame cut, abrasive cut, or machined. And this is true whether the job is a "toughy" or "run of the mill"!

When you need stainless steel plates—special patterns like these or plain rectangles—you'd better try Carlson service, where experience pays off.



Blank size: 2" thick x 60" OD

Stainless Steels Exclusively

G. O. CARLSON, INC.

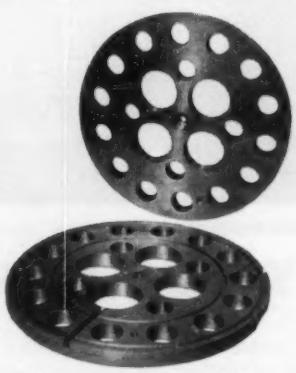
THORNDALE, PENNSYLVANIA

Plates • Plate Products • Forgings • Bars • Sheets (No. 1 Finish)

District Sales Offices in Principal Cities

Blank size: 3⅛" thick x 106½" OD

Blank size: ¼" thick x 75" x 88"



Blank size: 1½" thick x 26" OD

Simplest pneumatic controller to use and maintain

Bristol gives you improved stability of control action –but keeps basic simplicity of Series 500 Controllers

Bristol Series 500 Pneumatic Controllers are the easiest controllers on the market to use and maintain–still the most dependable and trouble-free.

The reason? The basic simplicity of the operating mechanism. *That* hasn't changed in the years since we introduced this long-time favorite among instrument men. Reason No. 2: they are equipped with famous Bristol measuring elements.

Easy calibration

It's this foolproof simplicity of the control system that makes calibration so easy on Series 500 controllers. *Only one* service adjustment is required and provided to exactly calibrate the control system. The control system can be completely disassembled and after reassembly (even with replacement of parts) can be restored to precise calibration with this *one* adjustment.

No special tools are required. A ¼-inch wrench is all that's needed.

The 500's completely interchangeable parts, accurately designed and manufactured to extremely close tolerances, make possible this built-in calibration.

And check these features:

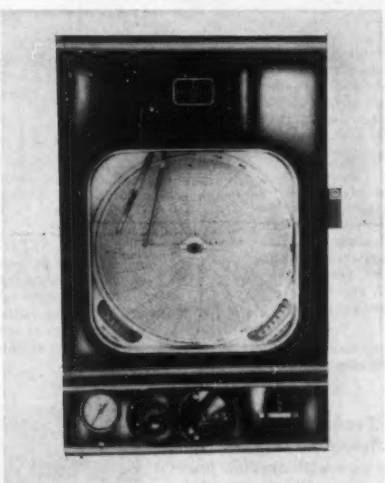
Improved control stability—advanced automatic control techniques have been applied by Bristol engineers to improve stability of control action in the new Series 500W Controllers.

Wide-band models offer choice of ½ to 400% proportional band with simple band shift.

True zero derivative setting—exclusive with Bristol.

Reset action stops in reset models—again a Bristol exclusive–prevent loss of control due to prolonged deviation from set point.

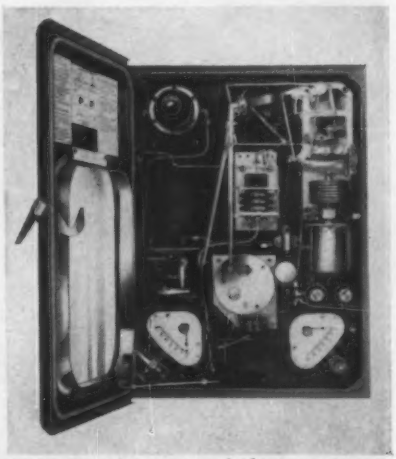
Four-position internal transfer station with automatic, manual, test, and service positions, plus pressure-matching button and manual pressure regulator, for maximum convenience in process control.



BRISTOL'S® SERIES 500 CONTROLLER, shown here with four-position transfer station. Internal station also available.

Complete data available

Write today for engineering data on Bristol's Series 500 controllers for your critical control problems. They're available for *automatic control of temperature, pressure, vacuum, draft, absolute pressure, liquid level, humidity, pH value, electrical measurements, and mechanical motion.* The Bristol Company, 111 Bristol Road, Waterbury 20, Conn.



FOUR-POSITION INTERNAL TRANSFER STATION shown here in interior view of Series 500 Controller. Permits remote manual control, testing and servicing without disconnecting instrument.

YOU CAN GET THESE CONTROL MODES:

1. **Fixed narrow band** (on-off)
2. **Proportional band**—½ to 100% and ½ to 30%.
3. **Reset with wide band**—rates 0.1 to 10 or 1 to 300 repeats per minute. Proportional band ½ to 400%.
4. **Derivative (rate)**—½ to 100% proportional band. Derivative time 0.2 to 20 min., plus zero derivative setting.
5. **Reset plus derivative**—proportional band and reset rate as in "reset" above. Derivative time as in "derivative" above.

YOU CAN HANDLE THESE CONTROL PROBLEMS:

1. Cascaded control 2. Selective control 3. Ratio control 4. Time-program control 5. Pneumatic transmission.

6.55

BRISTOL *TRAIL-BLAZERS IN PROCESS AUTOMATION*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Best way to solve your tube corrosion problems

What heat-exchanger tube alloy best meets *your* specific operating conditions? What effect will a change of alloy composition have on *your* operating and maintenance costs? Will future changes in operating schedules impair the efficient functioning of *your* tubes?

Best way to answer these and many other questions affecting your heat-exchanger tube selection is to ask Bridgeport. Our 60 years of tube manufacturing and corrosion research, backed by modern methods and facilities, have led to the development of a wide range of tube alloys to meet virtually every corrosion problem. Here are some of the standard tube alloys Bridgeport offers:

Admiralty—Good corrosion resistance to most types of circulating water at low velocities. Resists dezincification. Excellent corrosion resistance to clean fresh water and certain types of industrial and sewage pollution. A common choice for refinery heat exchangers where sulfides are present in petroleum streams.

Aluminum Brass—Excellent corrosion resistance to sea water. Resists impingement corrosion where water velocities are high. Excellent corrosion resistance to chlorinated sea water when chlorine is used for slime control. Excellent corrosion resistance to clean and polluted fresh water. Ideal for severe operating conditions.

Copper—Good general corrosion resistance. Good impingement corrosion resistance where water velocities are low. Immune to dezincification. Successfully handles esters, fluorides, oxygen, hydrogen, etc. Excellent heat-transfer rate. Widely used for heat exchangers, evaporators and condensers.

Cupro Nickel—Considered the best copper-base alloy for all-around corrosion resistance toward saline waters. Has unusually high strength at elevated temperatures.

Aluminum Bronze—Good general resistance to impingement and corrosion in brackish water and in areas where water is contaminated by acid wastes. Handles non-oxidizing salt solutions, glycols, esters, halogen derivatives, etc.

Red Brass—Good corrosion resistance in fresh water. Excellent resistance to dezincification. Satisfactorily handles chlorinated organic compounds.

Muntz Metal—Similar to Admiralty in resisting sulfur corrosion. Resists dezincification in sea water, brackish water and most fresh waters.

Duplex—The ideal answer to many dual corrosion problems. Widely used in exchangers handling hydrogen sulfides, chlorides, ammonia and various petroleum products. A range of over 101 combinations available for all refinery and chemical processes.

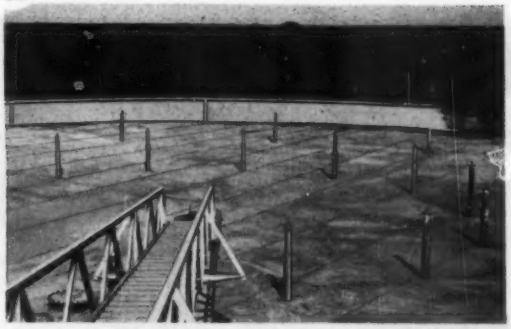
Bridgeport's Technical Service and Corrosion Laboratories are at your service to help you with specific problems. Call your nearest Bridgeport Sales Office for complete information.

The Bridgeport Condenser Tube Handbook *has 162 pages of valuable information on corrosion and how to combat it. Write for a copy.*

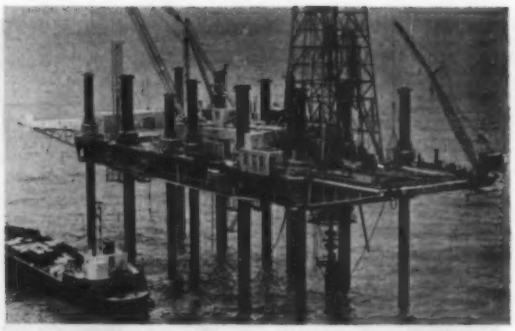
Brass Bridgeport Co.

BRIDGEPORT CONDENSER TUBES

Bridgeport Brass Company, Bridgeport 2, Conn. • Offices in Principal Cities
In Canada: Noranda Copper and Brass Limited, Montreal



on shore . . .



or offshore

your own painter can
"COLD GALVANIZE"
any steel surface with...

DIMETCOTE
* the 100% inorganic zinc coating

any **PLACE**

any **TIME**

any **WHERE**

Dimetcote is absolutely unique. It is not a paint, it contains no oils, resins or any other organic materials, yet it can be applied by spray or brush. When Dimetcote is applied to steel, a reaction takes place at the surface which produces chemical bonding as well as physical adhesion. It is almost impossible to find the interface between Dimetcote and the steel.

Dimetcote has many unusual characteristics. It shows no visible change after more than ten years exposure to the most severe weather conditions – sun, heat, fresh and salt water. It is insoluble in all solvents and petroleum products. It is highly abrasion resistant, but if abraded through to bare steel, the coating will cathodically inhibit corrosion.

Now tanks and structures can be given the same protection that galvanizing affords, *plus salt water resistance.* Existing structures need not be dismantled and new structures can be coated either before or after erection. *Only one coat* of Dimetcote over a sandblasted surface is required to protect such structures as:

Tank Exteriors • Cargo Tanks in Tankers • Dam Gates • Structural Steel • Christmas Trees • Buoys • Floating Roof Tanks • Offshore Rigs • Water Tanks • Barges • Ship Decks • Stacks

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4809 Firestone Blvd., South Gate, California
Please send illustrated folder on Dimetcote

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Title_____
Company_____
Address_____
City_____ Zone____ State_____

Amercoat® **CORPORATION**
4809 Firestone Blvd., South Gate, California

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360 Cornegie Avenue, Kenilworth, New Jersey
2404 Dennis Street, Jacksonville, Florida
6530 Supply Row, Houston, Texas

Steelwork Goes Up Quickly With High-Strength Bolting

Erection of steelwork for cracking towers and other types of refinery structures proceeds at a rapid pace when you use Bethlehem High-Strength Bolts to connect the structural members.

With Bethlehem High-Strength Bolts you get field connections that stay tight, even when subjected to vibration. The bolts are used in place of rivets, and are combined with two hardened washers, one placed under the hexagonal head, the other under the hexagonal nut. The nut is tightened with a pneumatic impact wrench, resulting in high clamping pressure.

Bethlehem High-Strength Bolts are economical because they can be installed by two men, one using a holding wrench, the other an impact wrench. The bolts are made from carbon steel, and meet the requirements of ASTM Specification A-325. They are carried in stock in a complete range of sizes.

If you have expansion plans in mind, we suggest that you discuss high-strength bolting with one of our representatives. The nearest Bethlehem sales office will be glad to hear from you at any time.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

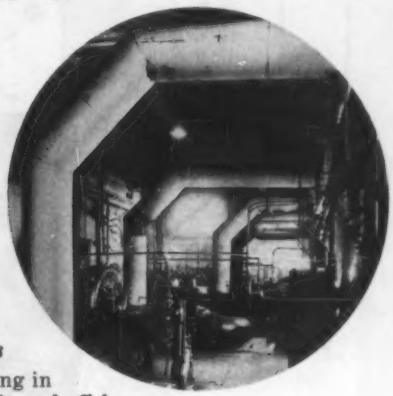
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

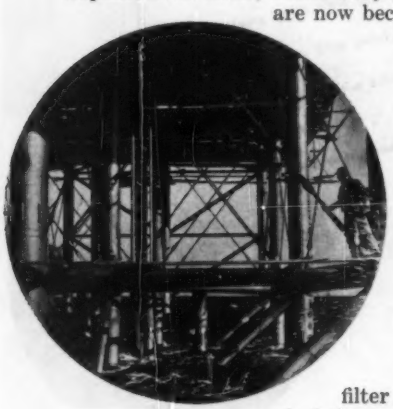
BETHLEHEM STEEL

How Monel pays off in equipment exposed to salt solutions

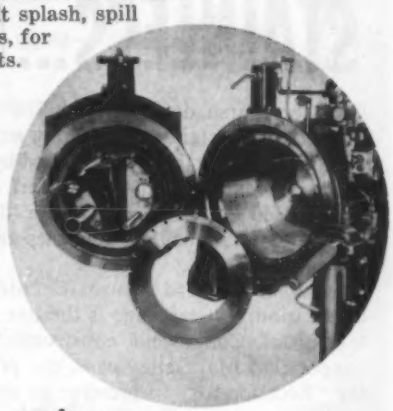
. . . pays off in pumps At Caloil's Perth Amboy refinery, this pump supplies 40,000 GPM of brackish cooling water. To counter the severe corrosive and erosive conditions, its shaft sleeves and 2200-lb. impeller are Monel* nickel-copper alloy. Monel alloy is a money-saver in seawater pumps.



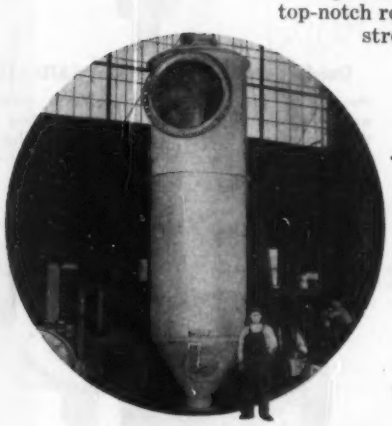
pays off in piping . . . In this California refinery, lightweight Monel lines proved able to handle salt water years longer than cast iron. This experience has been duplicated so often, Monel alloy piping, fittings, and valves are now becoming standard for such service.



. . . pays off in structurals The value of Monel alloy sheathing in preventing splash-zone corrosion of offshore structures like this is well-known. A less spectacular but equally valuable use is for plant structurals subject to salt splash, spill or atmospheres . . . tank supports, for example, or just plain nuts and bolts.



pays off in process vessels . . . These Sharples Super-D-Hydrators filter sodium sulfate crystals, wash them in brine and then dry them. Monel alloy provides just the needed properties for parts . . . . top-notch resistance to both corrosives, strength to handle high centrifugal forces, excellent fabricability.



. . . pays off in heat exchangers, condensers This barometric condenser is now in service at a large eastern sugar refinery. It features a Monel Clad Steel shell and solid Monel alloy internals. This construction has proved so effective in resisting the corrosive attack of brackish bay water that the refinery has standardized on Monel.

If your equipment for handling seawater and salt solutions is deteriorating faster than it should, an evaluation of Monel alloy in the application may prove helpful. Write Inco's Development and Research Division. *Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N.Y.

INCO TRADE MARK Nickel Alloys

Monel ***. . . for minimum maintenance***

For more data on advertised products, use Readers' Service Cards, last page.

Six choices of corrosion resistant tubes and sockets

4130 alloy steel tube with alloy steel tip and socket.

403 stainless steel tube with alloy steel tip and socket.

403 stainless steel tube with 416 stainless tip and socket.

316 stainless steel tube with alloy steel tip and socket.

316 stainless steel tube with 303 stainless tip and socket.

Monel tube with alloy steel tip and socket.

Tubes and sockets listed above are available in Type 100 Mastergauges which are designed for extreme service and pressures. Type 101 Mastergauges, for medium and high pressures, are available with:

4130 alloy steel tube, with alloy steel tip and socket.

403 stainless steel tube, with 416 stainless steel tip and socket.

403 stainless steel tube with alloy steel tip and socket.

STAINLESS...from socket to tip

Another Marsh development! The superlative Mastergauge is now available with stainless and alloy steel bourdon tubes. Try to find a corrosive service that isn't covered by range of materials listed above.

Tube, socket and tip—every part subjected to a corrosive medium—are fused into one piece by the "Connoweld" process . . . the exclusive process that distinguishes the Marsh Mastergauge from all other gauges.

Whether you need a gauge for corrosive service or any other critical application, Mastergauge is the one correct answer. It gives you the leak-proof Connoweld construction, the stronger, more durable copper-clad Marshalloy case, the precision Mastergauge movement, the "Recalibrator" to preserve its unmatched accuracy. Ask for data covering your specific gauge needs.

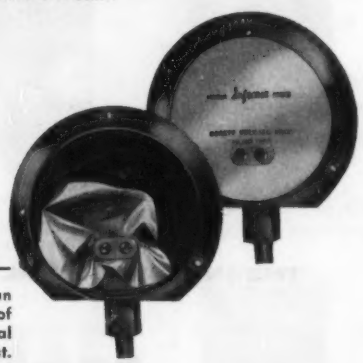
MARSH INSTRUMENT CO. Sales Affiliate of Jas. P. Marsh Corp. **Dept. R, Skokie, Ill.**
Marsh Instrument & Valve Co. (Canada) Ltd. 8407 103rd St., Edmonton, Alberta
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

MARSH GAUGES

"THE STANDARD OF ACCURACY"

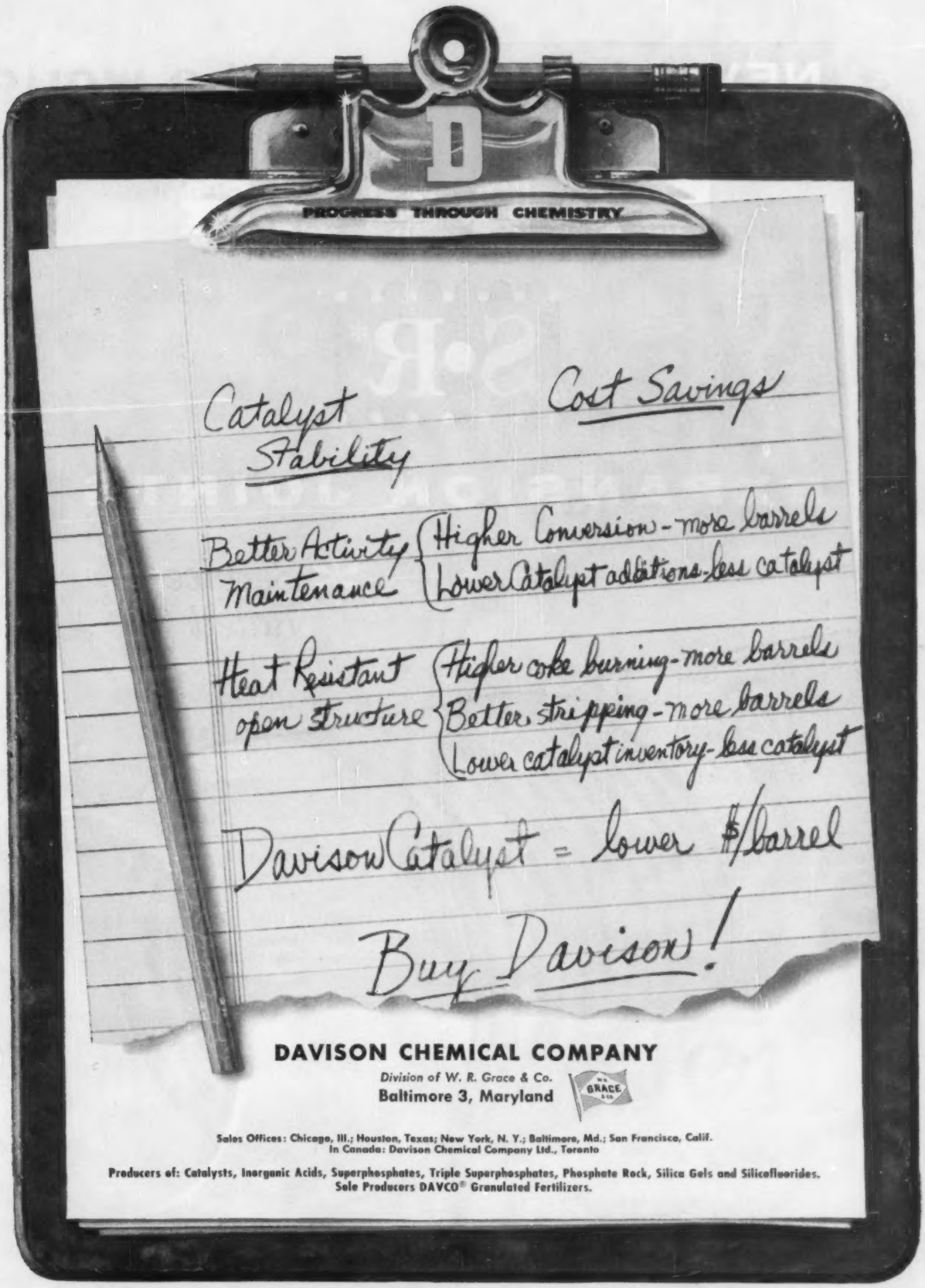
Stainless steel tube in the new SAFECASE

Here is a great combination . . . Marsh Mastergauge with corrosion resistant bourdon tube in the revolutionary Marsh Safecase . . . everything it takes for corrosive service where a surge of overpressure can occur.



Explosive force merely opens safety back—

Photo shows result of laboratory test in which gun cartridge was discharged in rear compartment of Safecase. Thin, tough back yields to abnormal pressure, but cannot be dislodged by blowout. Front of gauge remains intact, protected by heavy metal barrier.


D
PROGRESS THROUGH CHEMISTRY
Catalyst Stability
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Lower Catalyst additions - less catalyst
Heat Resistant open Structure
Higher coke burning - more barrels
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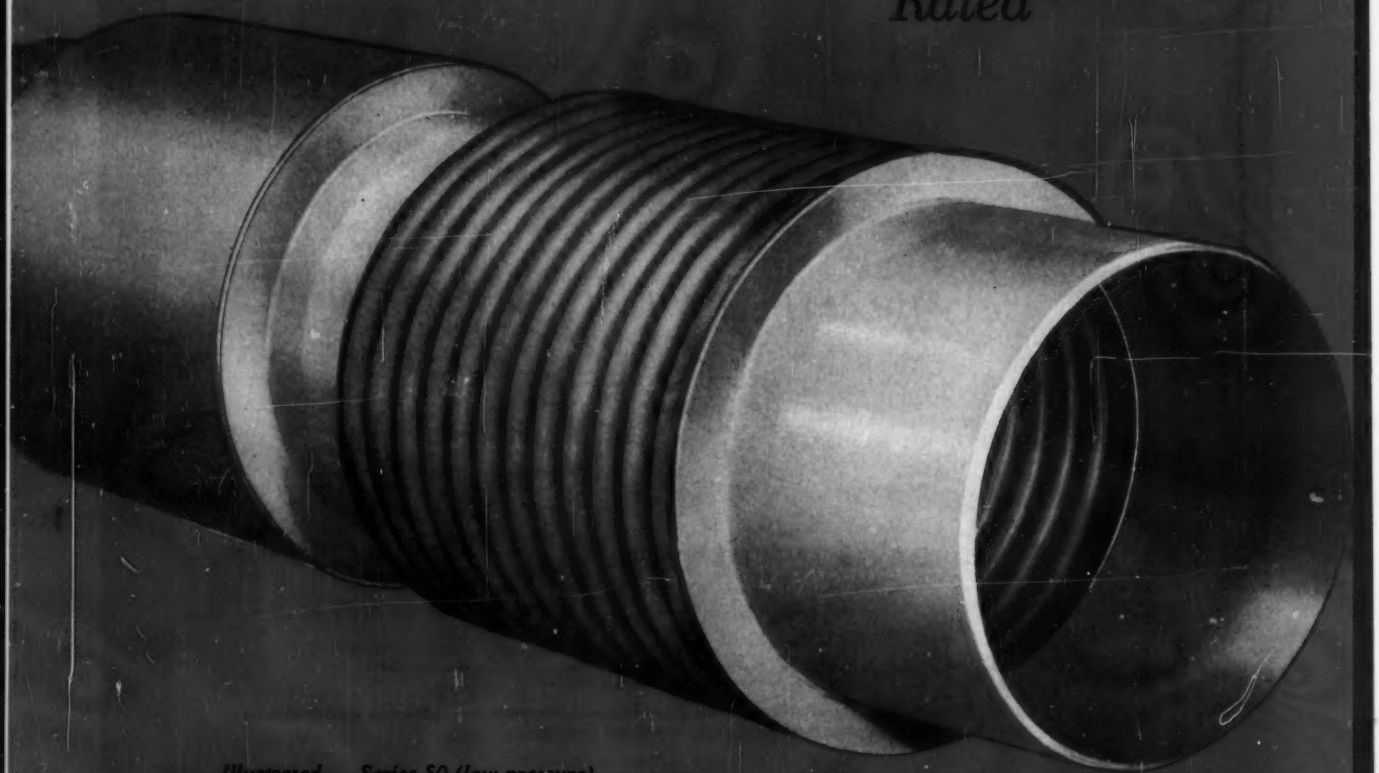
a **NEW DESIGN** from the world's r

BADGER

S·R*

EXPANSION JOINTS

* *Service-Rated*



Illustrated — Series 50 (low pressure) S-R Double Joint with welding ends. Cover removed from one bellows.

most experienced manufacturer

Revolutionary new design provides longer cyclic life... less weight... better equalization

Over three years of intensive research and testing have paid off! Badger S-R Expansion Joints — corrugated packless expansion joints of an entirely new design — are ready for your most exacting power, heating, industrial and process piping applications.

Two significant features of the new joints are 1.) Curvilinear Corrugations, which result in natural "all-curve" flexing and equal distribution of movement among the corrugations; 2.) tubular Reinforcing Rings, which work with the new corrugations to produce greater effective flexing height and "all-curve" flexing even under higher pressures and temperatures.

And there are other important features, too . . . size for size, Badger S-R Joints weigh up to 50% less than conventional types . . . new ring design reduces joint diameter . . . a complete line of accessories — including covers and liners — are available . . . standard models in stainless, monel and inconel, special types in any workable alloy.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Series 50 (low pressure) S-R Expansion Joints

The radically different Curvilinear Corrugations used in Badger S-R Expansion Joints were developed by the Badger Research Department. As shown in the cross-section of a Series 50 Joint (left), the design produces more uniform movement per corrugation and flexing to a natural "all-curve" shape, which results in lower stresses and therefore increased life. (White line in diagram shows the efficient "all-curve" shape the corrugations *naturally* assume under operating pressures.)

Series 150 (intermediate pressure) S-R Expansion Joints

Series 150 S-R Joints feature Curvilinear Corrugations and, because they are used at higher pressures, also have tubular Reinforcing Rings. A significant engineering improvement, these new rings make metal-to-metal contact only in the "valley" of each corrugation yet allow natural "all-curve" flexing (white line) when the pipeline is subjected to pressure. The tubular shape of the rings also permits greater effective flexing height and therefore contributes to longer joint life.

Learn more about ways S-R Joints can be of advantage to you . . .

New illustrated brochure describes them in detail — mail coupon for your free copy today.

© 1956 BMC

Badger Manufacturing Company
230 Bent Street
Cambridge, Massachusetts

Name _____

Company _____

Street and No. _____

City _____ Zone _____ State _____

"Personally,
I always specify
LEWIN-MATHES
Condenser Tube"

Lewin-Mathes welcomes stiff-necked specifications.

We meet them... because, as COPPER REFINERS, we control the exact composition of every alloy billet we form into condenser tube.

We meet them . . . because, as FABRICATORS, we control every step in the manufacture of Lewin-Mathes Condenser Tube from *raw material to finished product.*

We meet them . . . because, as INTEGRATED SPECIALISTS, we take pride in delivering every foot of Lewin-Mathes Condenser Tube uniform and perfect . . . "tailor-made" to perform better under *your* specific operating conditions.

Lewin-Mathes' mastery over every physical and chemical property of Heat Exchanger Tube can mean important savings for you. Bring your condenser tubing problems to us and see!

Nothing primitive about Lewin-Mathes service facilities. Expert technical and engineering assistance is available to you through 25 strategically-located Branch Offices.

LEWIN MATHES
SAINT LOUIS, MISSOURI
CUPRO-NICKEL CONDENSER TUBE
COPPER AND BRASS TUBE, PIPE AND ROD

For more data on advertised products, use Readers' Service Cards, last page.

Richard C. Waldron, Okonite's Manager of Engineering, explains:

How to tell right from wrong in plastic control cables

With hundreds of compounds to choose from, it's easy to make an incorrect choice when selecting thermoplastic control cable for refinery, natural gas and petrochemical use. The wrong choice can be extremely costly.

Specific Okonite plastic cable insulation and sheath compounds make your selection easier

Okonite has recently introduced several Okoseal (polyvinyl chloride) and Okolene (polyethylene) insulations and sheaths compounded to Okonite's own formulas. From these you can select the exact combination of insulation and sheath for your specific environment: salt water, petroleum oils, paraffinic hydrocarbons, alcohols, mineral acids, fixed alkalies, ketones, esters, halogenated hydrocarbons.

Make your selection from these new bulletins

Especially compiled for the petroleum and petrochemical industries, the following bulletins give complete technical information, including dimensions, on Okonite plastic cables for power, control, machine tools, lighting circuits, motor leads, switchboards, communications and cathodic protection.

THE OKONITE COMPANY, Passaic, N. J.
Kindly send me the free bulletins checked below.

- ☐ **BULLETIN 2120**—Insulated Power and Control Cable—600 Volts (Okoseal 100)
- ☐ **BULLETIN 2121**—Machine Tool and Switchboard Wire—600 Volts (Okoseal 200)
- ☐ **BULLETIN 2122**—High Ambient Petroleum and Chemical Resistant Wire—600 Volts (Okoseal 300)
- ☐ **BULLETIN 2123**—Oil and Gas Resistant Wire—600 Volts (Okoseal-Nylon, Type OGR)
- ☐ **BULLETIN 2124**—Multi-Conductor Control Cable—600 Volts (Okoseal 100)
- ☐ **BULLETIN 2125**—Insulated Power and Control Cable—0-5000 Volts (Okolene 400)
- ☐ **BULLETIN 2126**—Multi-Conductor Control Cable—600 and 1000 Volts (Okolene 400)
- ☐ **BULLETIN 2127**—Cathodic Protection Cable (Okolene 400)
- ☐ **BULLETIN 2128**—Relative Environmental Performance Data for Plastic Insulations and Sheaths

NAME.....TITLE.....
COMPANY.....
ADDRESS.....
CITY.....STATE.....

where there's electrical power... there's **OKONITE CABLE**

4324

Eleven lines of WALWORTH Saddle Type Wedge Gate Valves

Bronze-Mounted — All-Iron — Ni-Resist

Outside Screw and Yoke — Non-Rising Stem — Quick Opening

Flanged Ends — Screwed Ends

Walworth saddle-type wedge gate valves are manufactured in eleven different combinations of designs and materials, seven of which are illustrated above.

Saddle type wedge gate valves are easy to take apart and are particularly suitable for lines requiring frequent cleaning. Walworth Saddle-Type Wedge Gate Valves are available in a variety of designs including OS & Y; Inside Screw Rising Stem, and Sliding Stem Quick Opening types—in Bronze-Mounted, All-Iron, and Ni-Resist. All types are designed to permit repacking under pressure in either the open or closed position.

FOR COMPLETE INFORMATION, See your local Walworth Distributor or write on business stationery for illustrated circular.

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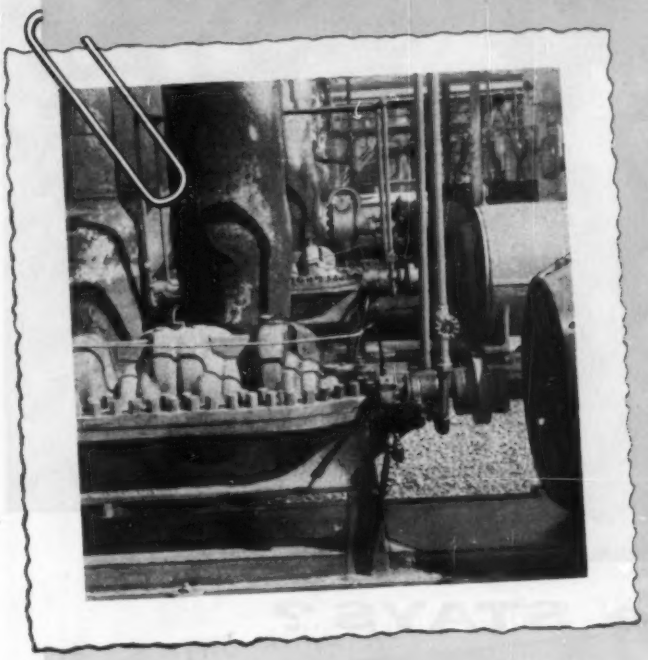
BJ FIELD ENGINEERS' REPORT

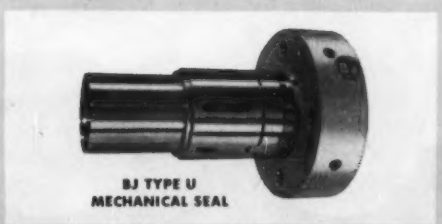
Subject: Texas Gas Corp. installation

BJ MECHANICAL SEALS BOOST OLD PUMPS' OUTPUT 124 GPM . . . ELIMINATE NEED FOR NEW PUMP INVESTMENT!



90% Saving on Piping!

After BJ Mechanical Seals were installed, approximately 90% of the piping was removed from the pumps. This maze of piping with packing had previously been necessary for cooling the stuffingboxes and for recirculating the high pressure leakage from the throttle bushings. Now there are only two lines used for handling cooling water to the bearing boxes and a 1¼" line running from seal cover to seal cover.



BJ TYPE U MECHANICAL SEAL

Expansion of the Texas Gas Corporation's Winnie, Texas refinery created a need for 120 gpm more output than the existing high pressure charge pumps were delivering. Two solutions were considered: (1). add another pump of the same size as the pumps already in operation; or (2). purchase a large single-capacity pump to replace existing pumps.

Working with Texas Gas engineers, Byron Jackson suggested a third solution: install BJ Mechanical Seals on the existing pumps. This eliminated the use of packing and throttle bushings and stopped the extreme leakage loss occuring at these points.

BJ Type U Mechanical Seals were installed on one of the pumps. Tests showed the flow rate was increased 62 gpm. The company immediately installed seals on their second charge pump. The new combined output of the mechanical-seal-equipped pumps was increased 124 gpm - more than sufficient to meet the expanded requirements.

In addition to this tremendous increase in pumping efficiency, other big benefits were realized: elimination of repacking expense and downtime losses; helpful savings in cooling water and piping; and a safer, cleaner working area around the pumps where formerly a "swamp" of leakage occurred.

Whatever your pumping requirements, it will pay you to investigate now the money-saving advantages of BJ Mechanical Seals. Call your local Byron Jackson office or write . . .

BYRON JACKSON PUMPS
INCORPORATED

A Subsidiary of Borg-Warner Corporation
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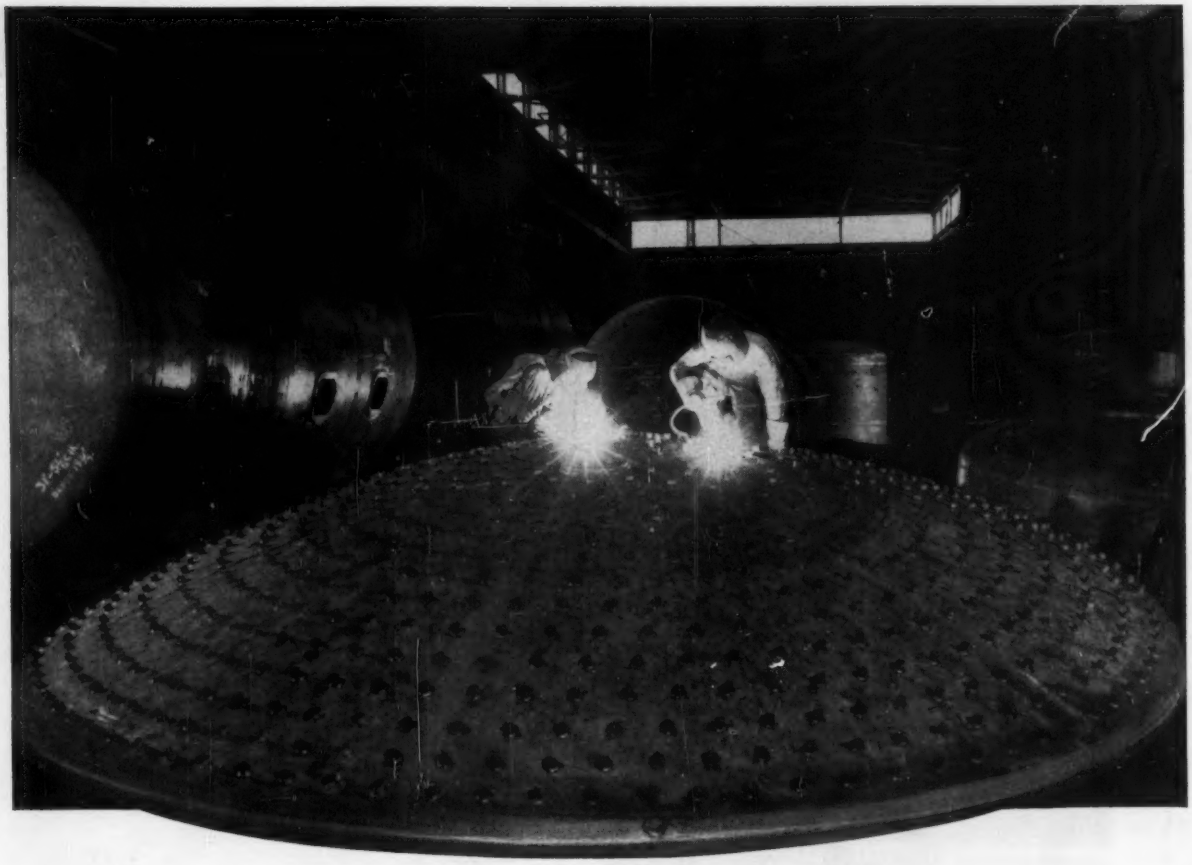
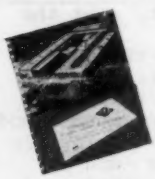
For more data on advertised products, use Readers' Service Cards, last page.



Why the STAYS?

Recently a large user of process equipment needed a 304 stainless steel jacketed autoclave. It was to operate at a working pressure of 110 lbs. per square inch, in the jacketed area.

The answer was a stay bolt construction (they're what you see in the picture above). This method allowed us to reduce head thickness—a technique that lowered cost considerably. This design also enabled us to improve delivery and conserve scarce nickel.



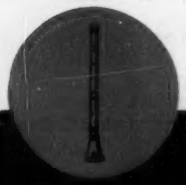
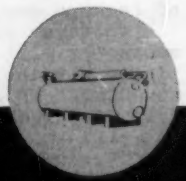
Users of alloy processing equipment (lots of 'em) are taking advantage of the skills and facilities of Chicago Steel Tank Company.

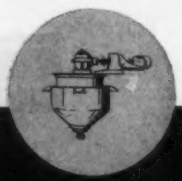
We can help you, too!

At Chicago Steel Tank Company you'll find a team of specialists that consider unusual fabricating requirements "duck soup." Why not? They're used to them. No problem with rigid customer specifications either. It's all in a day's work.

So when you need fabricated vessels and process equipment of any type or material, call us.

Write for Chicago Steel Tank Company new facilities booklet now. No obligation.



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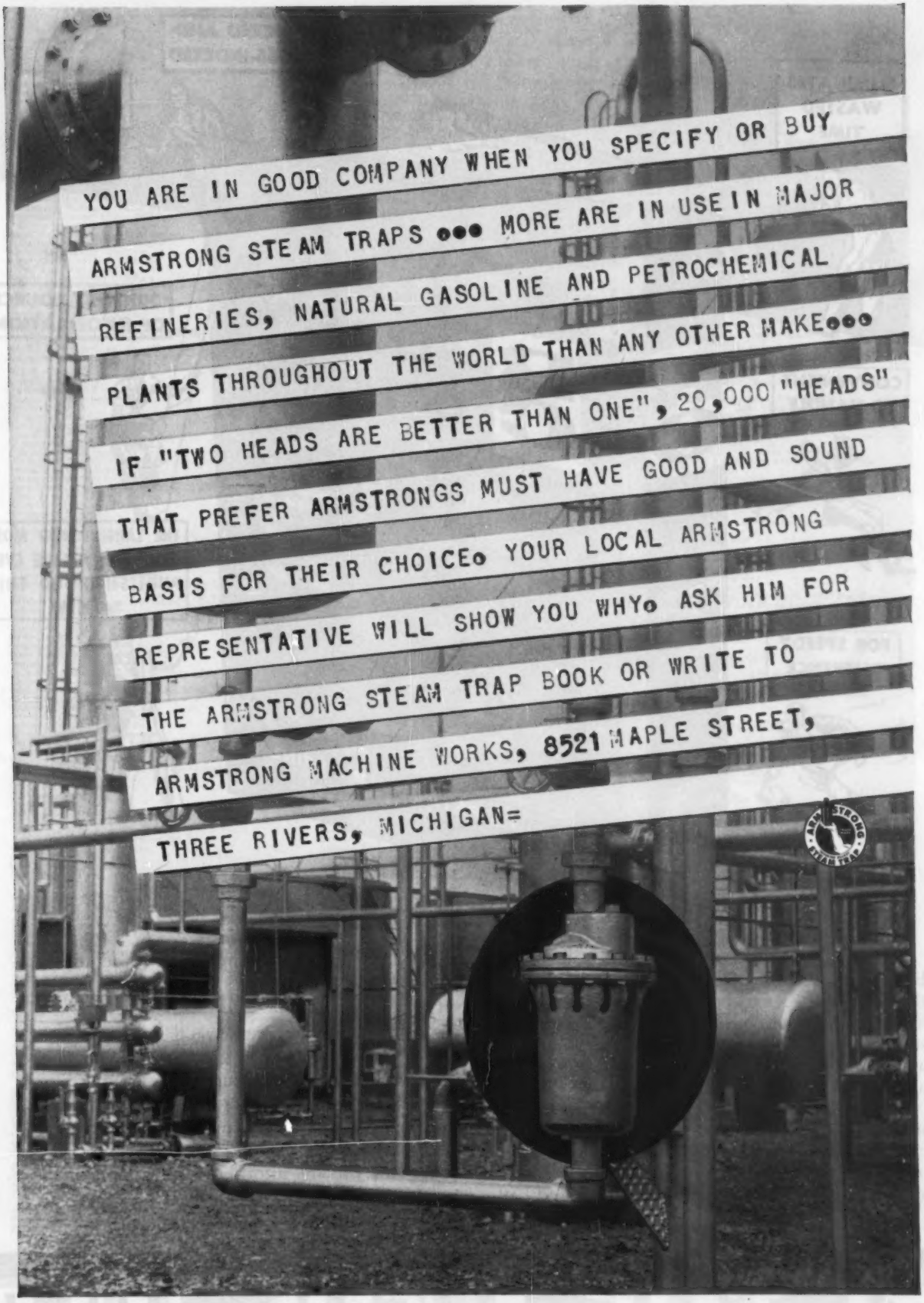
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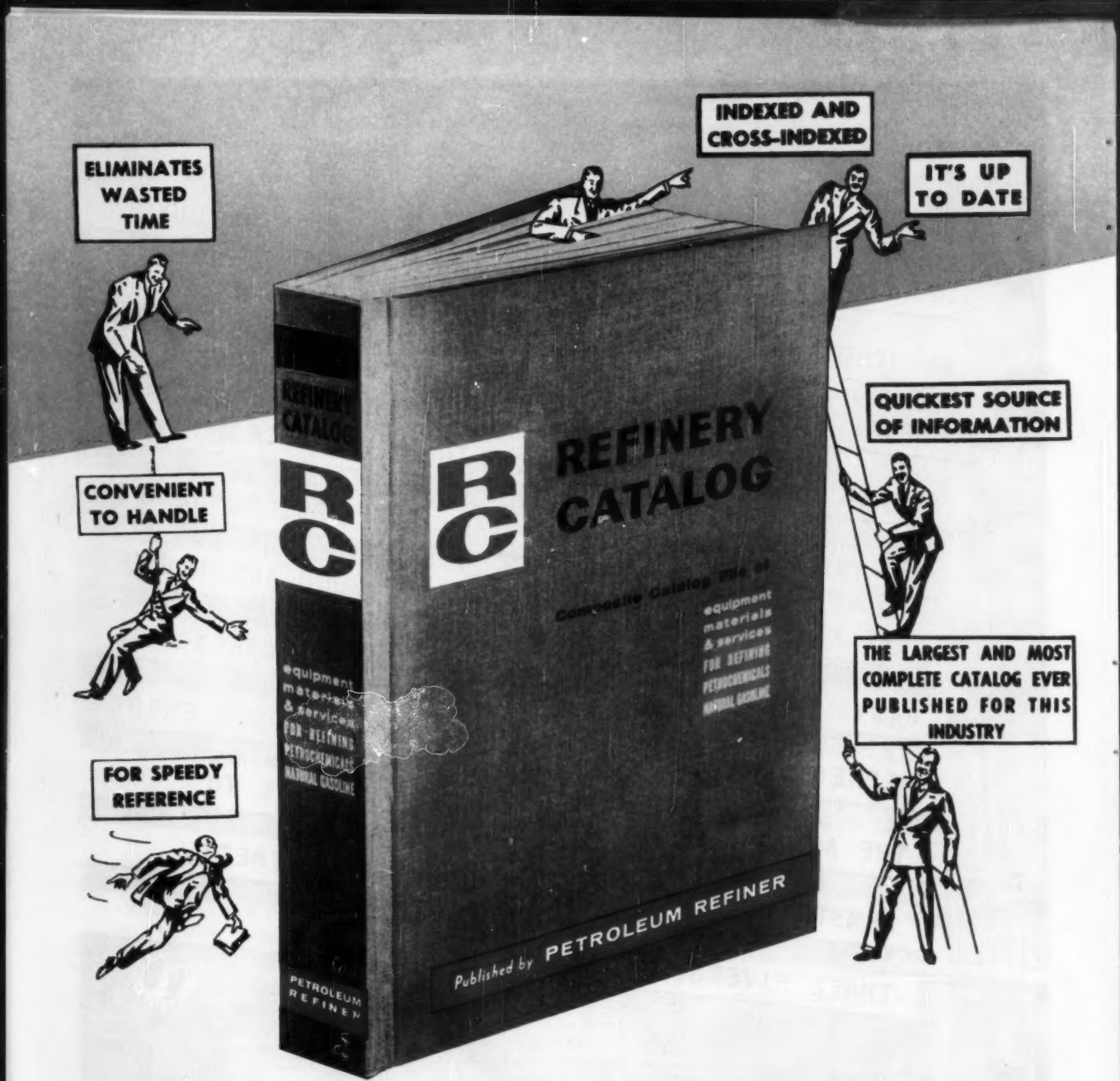
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The largest, most complete catalog ever published for the oil refining-processing industry, the new 1957 REFINERY CATALOG is serving as a genuine time-saver for operating executives, superintendents, foremen, engineers, purchasing agents and others who buy or specify equipment and supplies.

More than 300 leading manufacturers and suppliers have filed their complete or condensed catalog data in this edition. Compiled by the manufacturers themselves, this information is arranged and indexed to offer a quick and convenient means of locating items of equipment and services, and sources of supply of products in which you may be interested.

On the opposite page you'll find a complete list of companies whose complete or condensed catalogs appear in the current REFINERY CATALOG. When you're looking for data on products handled by these companies, be sure to check your REFINERY CATALOG. It is the most complete source of buying information available in one volume today.

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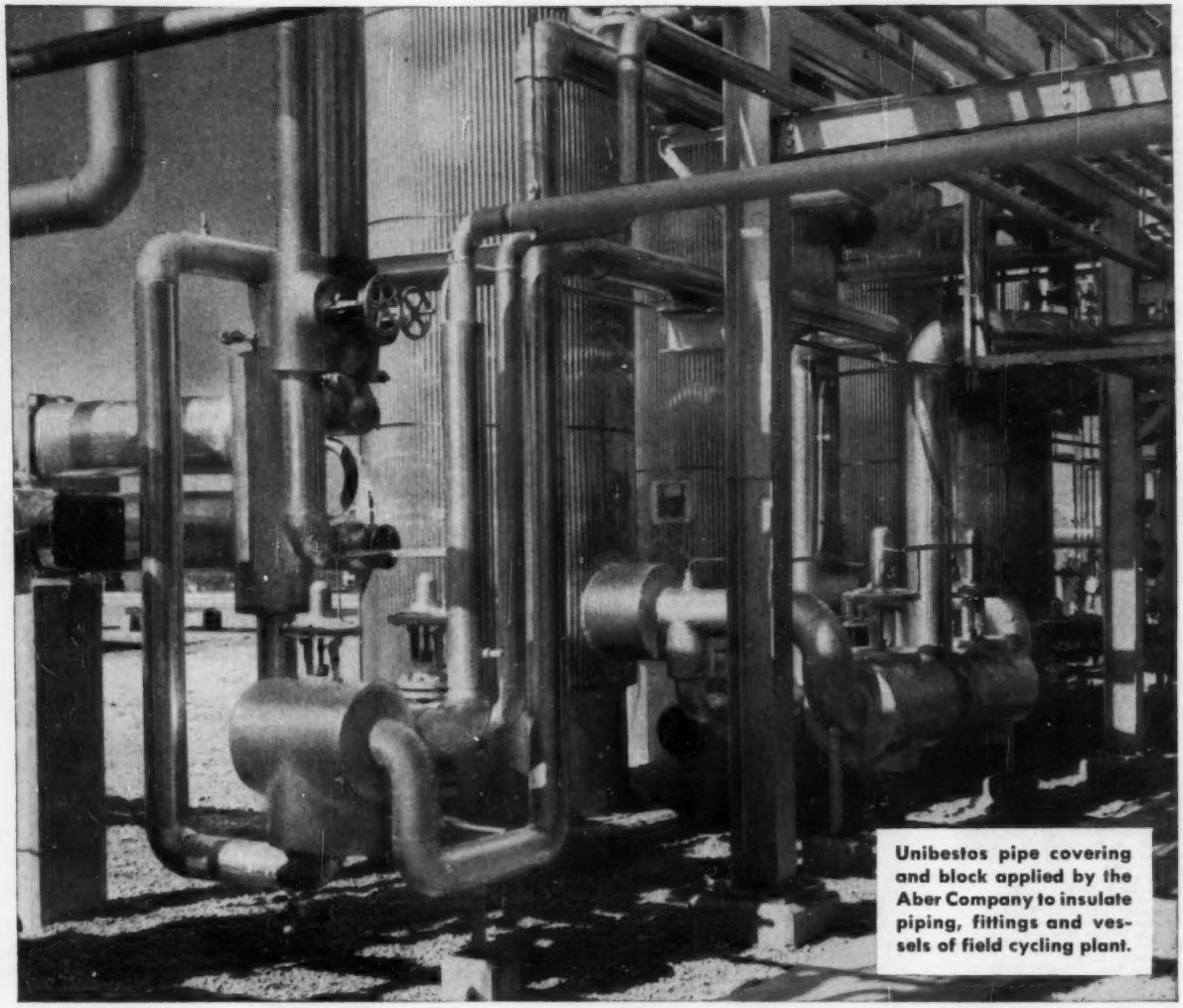

Unibestos pipe covering and block applied by the Aber Company to insulate piping, fittings and vessels of field cycling plant.

Unibestos makes hardest joints seem easy

Nothing is tougher to insulate than fittings. Yet whole networks of tees, ells, expansion joints and other fittings are required for today's refining process. Protecting these systems really tests the efficiency of any pipe insulation. And when it comes to cutting heat loss to a minimum, more and more refineries are relying on *single-layer* Unibestos®.

Unibestos gets its superior insulating properties from Amosite. This quality asbestos has long interlacing fibers that form positive heat seals at the joints—to provide protection without additional calkings.

And Unibestos has the strength to withstand shock...the stability to resist moisture, acid or chemical fumes. Easy to cut, miter or groove, single-layer Unibestos can be installed faster with virtually no cleanup. Unibestos pipe insulation is available in sectional form through 44″ O.D.

Joe Bestos says:

Only single-layer Unibestos is so simple to install on fittings. It cuts and handles easily without breaking.

Write for **FREE** descriptive Bulletin 109C.

UNARCO

UNION ASBESTOS & RUBBER COMPANY

1111 West Perry Street • Bloomington, Illinois

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the most ECONOMICAL maintenance is PREVENTIVE maintenance

TWO OF THE MOST EFFECTIVE PREVENTIVE MAINTENANCE MEASURES ARE:

1 *98% to 100% SALT REMOVAL with Tretolite Chemical Desalting*

Tretolite Desalting prevents salts, solids, trace metals and other impurities from entering the refinery stream. It prevents salt plugging and fouling in condensers, exchangers and towers, reducing clean-outs and tube rattling to minimum. Tretolite Desalting is an automatic, all-chemical process that consistently delivers salt removals in the 98% to 100% range.

2 *EFFICIENT CORROSION PREVENTION with Kontol Corrosion Inhibitors*

Kontol Corrosion Inhibitors prevent internal corrosion and hydrogen blistering and help to eliminate scale and fouling difficulties. Kontols are readily adsorbed from hydrocarbon solutions at metal surfaces to form a tough impervious film. In addition to their inhibiting properties, the Kontols are powerful detergents which clean and de-foul refinery equipment.

Ask the man in the red car

The Tretolite Service Engineer is always on call to assist you in your maintenance and processing problems.

AR-57-1

TRETOLITE COMPANY

A Division of Petrolite Corporation

369 MARSHALL AVENUE, ST. LOUIS 19, MISSOURI
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Chemicals and Services for the Petroleum Industry

DESALTING • DEMULSIFYING • CORROSION INHIBITING • SCALE PREVENTING
FUEL OIL ADDITIVES • WATER DE-OILING • METAL DEACTIVATORS

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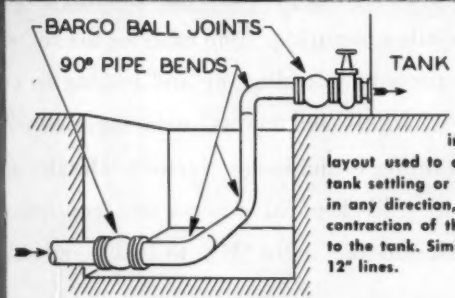
NEW

12" BARCO
Flexible Ball Joints
(also new 8" and 10" sizes)



FLEXIBLE!

This schematic diagram indicates the type of piping layout used to allow for up to 6 inches of tank settling or 6 inches of tank movement in any direction, and also for expansion or contraction of the long run of pipe leading to the tank. Similar piping is used for both 12" lines.

Built to Handle Big Tank Jobs!

One of the first places where twelve of Barco's new large size Flexible Ball Joints have been put to use is on three 170,000 bbl. West Coast tanks which receive crude from a new 12,000 ft. long 24" off-shore pipeline. As shown in the above photograph, each tank is connected by two 12" lines—each fitted with two 12" Barco Ball Joints. The joints provide the following advantages:

1. **Allow for tank settling or tilting. Also pipe expansion.**
2. **Isolate tanks against earthquake shock; also pump shock.**
3. **Maximum protection against Fire Hazards.**

For detailed information about new 8", 10" and 12" Barco Ball Joints, see our nearest representative or WRITE FOR NEW CATALOG 215B. Joints available in Bar-Ductile metal or steel; flanged or welding ends. 15° angular flex.

FOUNDED 1908 BARCO PRODUCTS BACKED BY EXPERIENCE

BARCO MANUFACTURING CO.
542B Hough Street • Barrington, Illinois

The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Revolving Joints
In Canada: The Holden Co., Ltd., Montreal

The Mail Box . . .

Wants a Job

To The Editor:

In your October issue, two doctors of DuPont's say some consoling words and give advice to those approaching 65 and make suggestions on how to pass the last years of life.

I need no coaching, having practiced retirement for over ten years. In August, 1946, they declared me to be useless. A few months later I was teaching at a university and directing research and felt that I had come to the fountain of youth. But alas, after another five years I was again officially useless.

My wife and I are living here in a beautiful exile. With our income it would be impossible to exist decently in the United States and to continue the subscription to the REFINER. Now I am keeping busy with my hobby, studying languages and doing some translating. When I had seen the soothing sentences in "Where do we go from 65?" that after 65 there comes 70, and then it is time to prepare for departure, I went to a clinic for a checkup. The doctor summed up his observations in the curt sentence: "You are going to live to be 100."

What am I going to do? Please, find a job for me.

Paul Zurcher

Lugano, Switzerland

Liked Symposium

To The Editor:

The type of symposium ("Higher Octanes or Not?" July, 1956, PETROLEUM REFINER) is very much worthwhile. It helps to clear the atmosphere relative to newspaper speculation about turbine-driven automobiles. I feel that you gave good coverage—you can't go into a lot of detail on some of the pertinent points since data are not released by the refiners. A little more specific information on the cost to the refiner of increasing octanes would be desirable to round out the picture. You did well to go to the automotive industry, and you got papers from the big three (since Lamont Eltinge used to be with General Motors). Eltinge did a swell job. I liked the controversy injected by G. J. Huebner of Chrysler. This sort of thing stimulates thinking—and interest! I would have liked a little more

AUTHENTIC
Western Heat Exchanger
CASE HISTORY

CUSTOMER: *Spencer Chemical Company*

WESTERN'S *Speed and Flexibility*

PUTS SPENCER PLANT BACK *ON STREAM*

IN JUST 47 HOURS!

SCHEDULE OF OPERATIONS
MARCH 29-30-31

At Spencer Chemical Company's Jayhawk Works at Galena, Kansas, on March 29, 1956, oil was bled into a compressor air aftercooler, through a valve failure, causing a fire in the shell side of a heat exchanger, completely melting out the admiralty extended surface in the air aftercooler. THIS RESULTED IN A LOSS OF 130 TONS OF NITRIC ACID PER DAY!!

The ability to redesign a prime surface exchanger to handle the heat load originally handled by a special extended surface bundle, and to fabricate from stock materials in thirty hours, emphasizes the importance of Western's speed and flexibility to our Engineering and Operating clientele.

Western merits *your* consideration on present and future heat transfer requirements.

5:40 p.m., Mar. 29

Call from Spencer Kansas City office, requesting retubing of an existing bundle of unusual design.

8:30 p.m., Mar. 29

Following engineering meetings on problem, Western engineer travels to Spencer plant, inspects damage, sketches existing tube sheets and other details affecting bundle fit; returns to Tulsa same night.

7:30 a.m., Mar. 30

Based on heat load, air quantities and flow, new rating is performed, permitting bare tube, prime surface bundle to do job of original specialized extended surface tubes, staying within pressure drop limitations on shell side of unit.

10:00 a.m., Mar. 30

Drafting Department starts on tube sheet layouts, from completely rated unit. Complete bundle drawings in hands of Shop by noon.

12:00 noon, Mar. 30

Stationary tube sheet, fixed tube and baffles drilled on three presses, with crew cutting 600 ¾" x 16 BWG x 20' admiralty tubes to 17' 2" lengths.

9:00 p.m., Mar. 30

Bundle completely assembled, electronic torque controlled rolling of 600 tubes at stationary and floating tube sheets begun. Completed, crated, and shipped by midnight.

4:15 p.m., Mar. 31

Spencer plant back "on stream," having received bundle at 5:30 a.m., completely installed by 10:00 a.m.

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HEAT EXCHANGERS

WESTERN SUPPLY COMPANY
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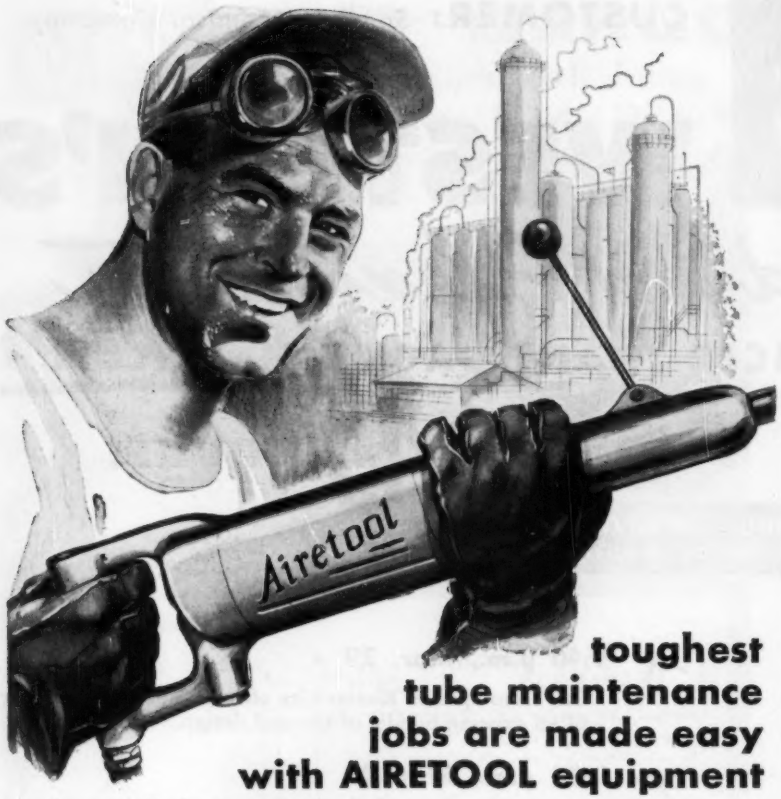
HUDSON-RUSH COMPANY — 753 Gladstone Blvd., Shreveport, La.
130 Casa Linda Plaza, Dallas, 18, Tex.
P. O. Box 3151, Amarillo, Tex.

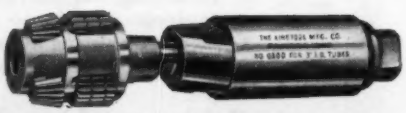
PROCESS INSTRUMENTS & EQUIPMENT CO. — North Bldg., Charleston, W. Va.

H. W. SEVERANCE — 2416 Frankfort Ave., Louisville, Ky.



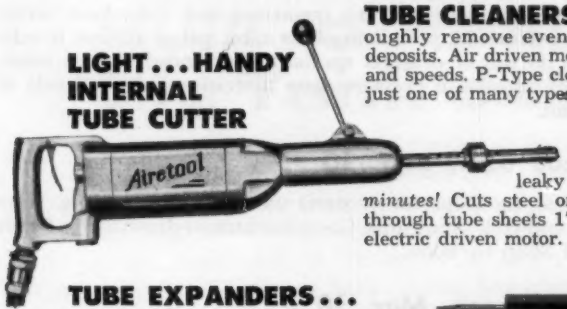
toughest tube maintenance jobs are made easy with AIRETOOL equipment

See for yourself why so many refinery engineers specify AIRETOOL for their tube maintenance programs. AIRETOOL Equipment handles easy . . . is rugged, packs plenty of power and speed, won't bog down or break down during use. AIRETOOL does the *best* job, quickly, economically.



POWERFUL...FAST CUTTING TUBE CLEANERS quickly and thoroughly remove even hardest scale and deposits. Air driven motors in various sizes and speeds. P-Type cleaner head shown, is just one of many types available.

LIGHT...HANDY INTERNAL TUBE CUTTER



New . . . removes leaky or damaged tubes in *minutes!* Cuts steel or non-ferrous tubes through tube sheets 1" to 4" thick. Air or electric driven motor.

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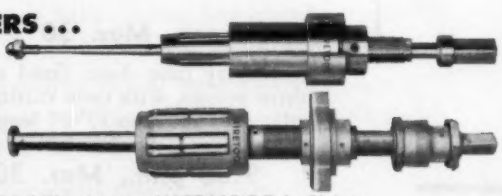

Write for illustrated literature on AIRETOOL'S Tube Maintenance Equipment, or see your nearest Airetool Representative.

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The Mail Box . . .

detail by A. E. Cleveland ("Fuel Injection Changes Emphasis")—especially in conjunction with how fuel injection works and how this affects volatility and octane level. He did a good job as far as he went. (Perhaps that's as far as he wanted to go.)

You can follow up on this. Go to the automobile manufacturers and several refiners. Show how it is necessary to work together to provide lubes and gasolines to meet planned requirements of the auto manufacturers. Also, you can show how refiners solve some of the manufacturers problems.

Again, this sort of thing is good—keep it up!

William G. Domask
315 Holly Drive
Baytown, Texas

"Excellent Series"

To The Editor:

These (PR's July symposium on "Higher Octanes or Not?") are an excellent series of articles. They are short, informative, to the point, timely articles.

More of this type should appear in the REFINER. Many of us do not have the time available for articles 6-10 pages long—they require too much time to separate the meat out of the article. We, therefore, appreciate your editorial staff's efforts to bring us these important facts in concise form.

Thank you for permitting me to comment on these articles.

Harry G. Doherty
Pitman, New Jersey

Has a Suggestion

To The Editor:

Thanks for the reprint (of PR's articles dealing with higher octanes). I read this group of articles when it appeared, and found it very helpful.

The only specific comments I'd suggest for improving this sort of thing is: Be a little more specific in naming cars and known changes. Such magazines as *Popular Mechanics* tell us more about what the 1957 Chrysler will introduce or what automobile companies are doing about fuel injection, than any oil industry publication. This is a shame—we look to you to get all available information about new trends.

C. S. McCoy, Jr.
Orinda, Calif.

In water conditioning... one grows taller than the rest!

W. H. & L. D. BETZ, Philadelphia, Pa.

How Buell's Exclusive Rapping Mechanism delivers Extra Dust Collection Efficiency

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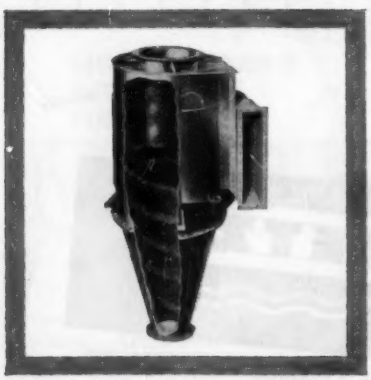
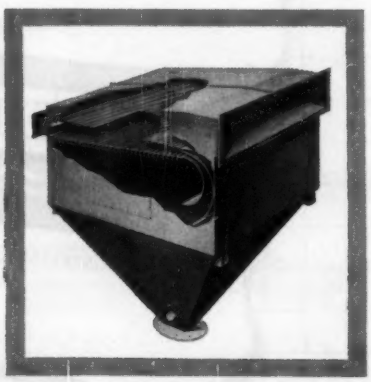


Buell Cyclones offer two "extra-efficiency" advantages: (1) exclusive Shave-off which harnesses double-eddy and puts it to work, and (2), large diameter design which eliminates clogging.

Complementing the extra efficiency of rapping in Buell "SF" Electric Precipitators, the unique Spiralectrodes add further efficiency through 50% to 100% higher electron emission, constantly accurate spacing, longer electrode life.



Buell's Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for natural or forced draft installations. Ideal for boilers from 100 to 2000 BHP.

For more specific data about Buell's *extra efficiency*, write Dept. 21-A, Buell Engineering Company, 70 Pine Street, New York 5, N. Y.

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A Quick Look at the Industry THIS MONTH

'56 In Review . . . Here's what U. S. refiners and producers accomplished in 1956:

- **Increased refining capacity** to 8.95 million barrels daily, compared with 8.63 million in '55.
- **Upped motor fuel output** more than 60 million barrels.
- **Showed only a slight increase in fuel oil output** while demand jumped 67 million barrels.
- **Set a new record (and a problem, too) for year-end crude and products stocks**—753 million barrels (mostly gains in natural and refined products).
- **Provided the U. S. with 9.4 million barrels of crude, natural gas liquids and imports daily**—nearly 600,000 bpd more than in '55. First time in industry history that supply has passed 9-million-bpd mark.
- **Crude production** reached 7.2 million bpd, 351,000 barrels per day more than '55.

—•—

Outlook for '57 . . . Refiners and producers will enter '57 with three major problems: (1) Task of relieving oil products shortage in Europe. (2) Job of working off large domestic gasoline inventories which accumulated in '56 (on December 14 gasoline inventories totaled about 17 million barrels, or 10 percent over the same date in '55). (3) Increasing oil-finding and development costs with no balancing crude price increases in past 3½ years.

Result: General crude oil price increase—in the offing for many months—may soon be with us. Increases in U. S. output and demand may not match '56 rates.

Money will continue to be tight. However, refiners will be able to get loans for expansion—at higher interest rates. Small independents will be hit hard by tight money year of '57.

—•—

Products for Europe? . . . Look for action soon on mounting refiner requests to move substantial amounts of excess gasoline stocks to Europe.

Interior Department has appointed refining expert William R. Argyle, retired Sinclair veep, as consultant. His job: To study increased burdens being placed on refiners as result of stepped up shipments of crude from Gulf Coast, instead of products.

—•—

New Activity in Shale and Tar Sands . . . Some good may come out of Suez crisis after all. Lease holders of oil sands and shale have been impressed with increased activity in sales since beginning of Nasser's folly.

If Canal is tied up more than six months, Union oil will do much more than shake down its new 300-ton-per-day shale oil plant near Grand Valley, Colo.

A Quick Look at the Industry (continued)

Postings on Octane Race . . .

Some refiners are beginning to feel a real financial pinch in keeping pace with the octane scramble. Look for more companies to stay in the regular gasoline class because of increasing cost of making high octanes.

Next step, process-wise, is isomerization, but it has not proved economical in most cases.

Activity is stirring up in the tetraethyl lead field. First came the Ziegler process out of Germany (some are not convinced this method can be used commercially). Now Ethyl Corp. has announced great hopes for its new process, now in the evaluation stages.

—•—

Automatic Refining Is on the Way . . .

Esso is gradually approaching "fully automatic" refinery stage. Latest development: Esso, S. A. is installing Model IV 24,000 bpd fluid catalytic cracker with built-in general purpose analog computer and log sheet printer at its Belot refinery near Havana, Cuba. Computer's purpose: Work out computations required to optimize process operations. Answers will be provided in minutes which previously took engineers a day or more to compute.

—•—

Pens from Oil . . .

Last year, in producing more than one quarter billion pens, the ball point pen industry consumed more than a million dollars worth of petrochemicals. Among these were about 4 million pounds of plastics, ½ million pounds of paste inks and 150,000 pounds of dyes, solvents and resins.

—•—

Atoms and Oil . . .

Shell Development reports new bombardment processes are paving the way to plastics strong enough for automobile bodies, aircraft and structural members for buildings. New products will come from treatment of ordinary plastics with high-energy beams of electrons and other atomic particles accelerated to speed of light and then fired into material being processed.

—•—

New Future for Aromatics . . .

Indiana Standard's newly developed direct-oxidation process promises a great future for petroleum aromatics. Process uses air for simple, direct oxidation of basic aromatics—can make several different di-basic acids by switching feedstocks—can handle mixed aromatics to make their respective di-basic acids.

Several domestic and foreign companies are contracting with Indiana Standard to use the process.

—•—

New Oil Fields Show Promise . . .

U. S. drillers presented the nation with 70 new oil fields during November and only the usual few looked significant. Five of those were: Two located in Lea County, New Mexico, by Cities Service and Sinclair, and potentialed for 1022 barrels of 42-gravity oil and 484 barrels of 60-gravity daily, respectively; another by The Atlantic Refining in Gaines County, West Texas, flowing 415 barrels of 27-gravity oil a day; Republic Natural's discovery in Pecos County, of the same area, making 562 barrels of 43-gravity; and one that may prove to be the most important find of the year in the Southeastern states. That one

If Oil Could Speak

If oil could speak it would have many fascinating truths to tell the non-oil public—truths that would win thousands of new friends for the oil industry.

But, oil can't speak—you can. You, as an individual, can win many new friends for the oil industry if you will pass the true facts on to your non-oil industry friends.

Here are some of those true facts. They are being presented for one purpose: To keep you posted on your industry, so you can tell the story oil is unable to relate.

Read these facts. You will find them informative—and interesting.

"If Oil Could Speak" it would tell the American public:

•

• Last year, the oil industry paid more local, state and federal taxes than any other industry—nearly $5.5 billion, excluding employe income taxes. The oil and gas industry paid Texas $191 million in taxes last year—about one-third of all tax and license revenues paid by industry and business in the state.

•

• In a recent survey, three out of four people thought most of the oil refining done in this country was by three or four large companies. The truth is, the four largest companies do only 37.3 percent of the oil refining, and this ratio is smaller than it was in 1930.

•

• One-fifth of the world's 57 million square miles of land area has oil potential. Of that one-fifth, much less than another one-fifth is located in the U. S. Yet the U. S. has produced 60 percent of all the oil produced to date. Last year alone, our oil producers achieved an output of more than 7 million barrels a day. Private enterprise did it, competition speeded it up.

•

• We are not running out of oil. During the first ten months of 1956, U. S. oil companies discovered more than 1193 new fields, of which 901 were oil and 292 were gas and distillate.

•

• Twenty-five years ago, proved reserves *worldwide* were estimated to be equal to 15 years of production at the 1931 rates. Now the world production rate is four times what it was in 1931, yet exploration has been so successful that present reserves are equal to 33 years at present rates. Again, private enterprise and competition have been responsible for nearly 100 percent of our oil discoveries.

•

Remember: Oil can't speak—you can. Only you can give the non-oil public the true facts about your oil industry.

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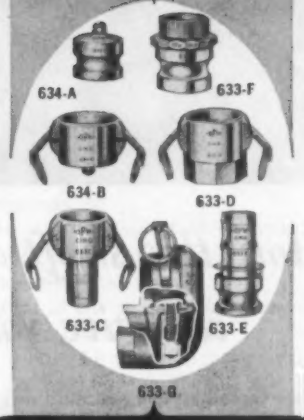

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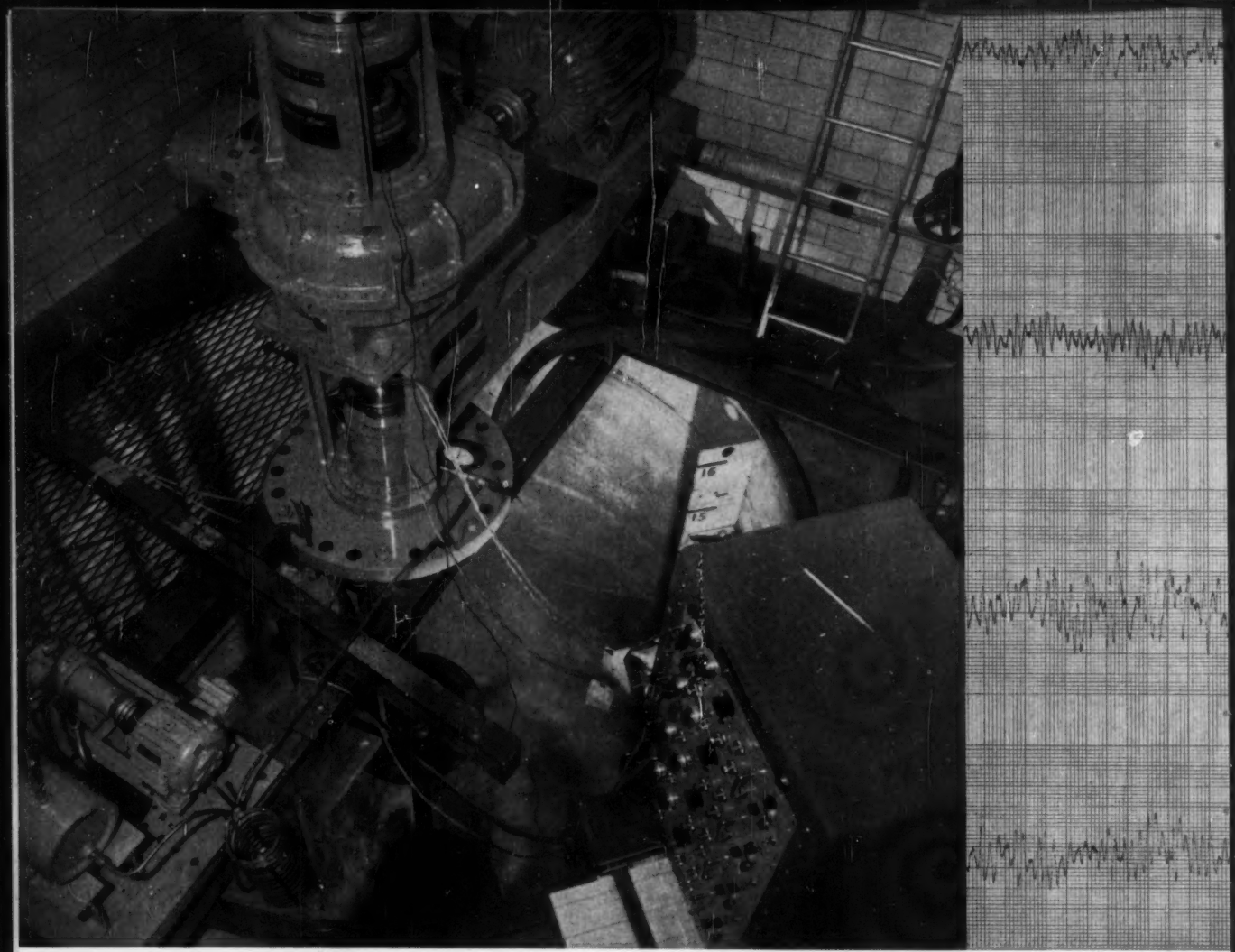

How this shaft deflection test can give you **better fluid mixing**

Some secrets of efficient fluid mixing lie hidden beneath the tug-and-pull of fluids buffeting this LIGHTNIN Mixer's impeller.

These fluid forces are beginning to yield clues that can help you get improved mixer design and lower mixing costs.

Solving the seal dilemma

For example, if you're mixing fluids under pressure or vacuum, you probably want the great operating economy of a rotary mechanical seal.

You want the shaft diameter large enough to run with minimum deflection, to keep the sealing faces accurately aligned—but not larger than *really* necessary.

Seeing what deflection looks like

That is one reason why, as the 4-inch shaft on this 50-horsepower LIGHTNIN test unit revs up toward its natural vibration frequency, four MIXCO-designed strain-gage pickups start "taking the pulse" of the rotating shaft.

At the recorder, four electric styli trace a profile of the frequency and amplitude of shaft deflection during the run, in various liquid depths, and under different conditions of impeller size, location, and tank baffling. The data are accurate to 0.0005 in.

Combined with continuous torque measurements, this composite profile provides basic data for computing the stresses acting in the shaft.

Getting rid of a bearing

Efficient mixer shaft sealing is only one product of these test runs. They also permit highly accurate design of overhung shafts to operate without a steady bearing in the tank bottom, thus eliminating a major maintenance cost item.

This is one of the new directions MIXCO research is taking. Our research department welcomes the opportunity to cooperate with you in any phase of your work leading to more efficient fluid mixing.

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A Calm Look at Chaos

THE TIME IS LONG past due for a *calm* appraisal of the U. S. scientist-engineer "shortage."

First of all, there is considerable question about the term, shortage. Perhaps it would be better to say, "a problem in providing scientists and engineers to meet the nation's needs." This more general term would thus allow such factors as better utilization of manpower to be included.

No matter what you call the present situation, there is little justification for some of the actions being taken to solve it. One of the most damaging of these is the public use of fear techniques. Using scare tactics to send industry, at times, near the brink of chaos in its pell mell quest for technical manpower can result in three things: Disorganized confusion—over-emphasis of the problem—possible creation of an over-supply of scientists and engineers, which could create more problems than a shortage.

By *scare tactics* we mean the public reference to Russia's expanding technical forces which "threaten to send our nation to its doom and destruction through scientific and engineering obsolescence." To say that these carefully tailored emotional outcries are grossly exaggerated, is a gross understatement.

By *disorganized confusion,* Webster's definition of "chaos," we mean the frantic recruiting practices of industry—apparent plans to funnel a large number of high school students into technology with little or no regard to aptitude, and ultimately, quality. And these are just a few examples.

By *over-emphasizing the problem* we mean the wide publication of so-called statistics to dramatize the shortage, i.e., the inadequately small number of engineering and science graduates, compared with the jet-like acceleration in U. S. population, products, research and industry growth.

What About Surplus?

The combination of the above three factors, if carried to extreme, could create a surplus of technical manpower within 15 years, according to Dr. C. L. Wilson, president of Hudson Chemical Co. This possibility becomes even more apparent in light of the seldom publicized fact that the present shortage of college graduates is mostly due to the low birth rate of the thirties. Statistics show that by 1960, graduate engineers and scientists are expected to total 80,000, compared with 54,000 in 1955.

Whether such future increases above the present total of 700,000 engineers and 250,000 scientists can keep up with the nation's need appears to be the current point of contention, with two sharply opposing sides.

While the arguments wax hot, and frantic actions continue, answers to the problem are being calmly sought by more than 20 industry, education and government commissions. These agencies are diligently and thoroughly analyzing the situation. The results of their efforts should be studied—and heeded—by every industry.

The Source and the Solution

Recent studies show that the current problem can be traced to three principal sources:

- The decline in recent years in the total number of people reaching the age when they might enter the fields of science and engineering.
- The decline in the percentage of eligible people who actually choose to embark on a career in science and engineering.
- The continued expansion of the demand for scientists and engineers growing out of our continuing technological expansion.

Objective appraisal of the problem has come forth with the following suggestions to date:

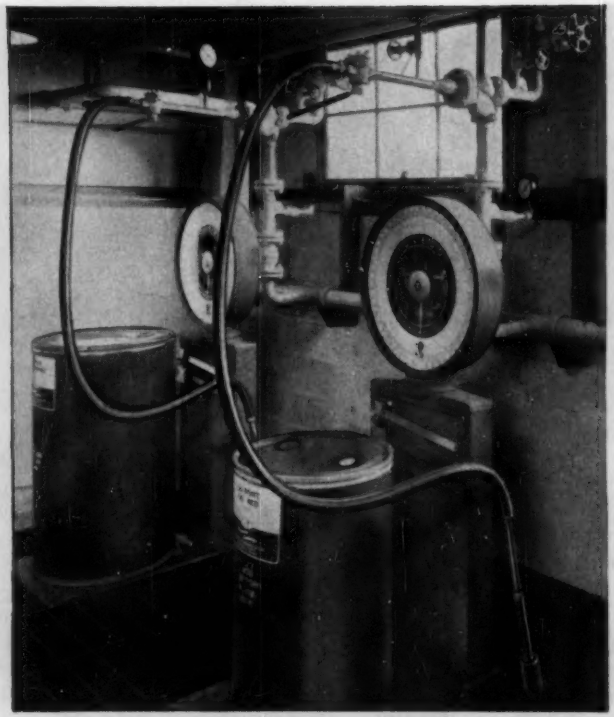
1. Every effort should be made to insure that existing scientific skills are being used most effectively.

Dr. Lee Dubridge, president of the California Institute of Technology, has suggested that if industry could utilize its engineering staff just five precent more effectively, the net gain would be larger than the total number of engineers who will receive degrees this year.

2. Industry should estimate, as accurately as possible, the annual manpower needs expressed in terms of specific technical skills requiring scientific training at the college level.

An extensive study by the B. F. Goodrich Company shows that scientists are now being graduated at the rate of 186 out of each 1000 students who receive first degrees. To meet our basic needs for continued growth and expansion, 205 to 215 out of each 1000 should become scientists or engineers. The tight supply could therefore be eliminated if just 20 or 30 more students out of each 1000 graduates attained degrees in science and engineering.

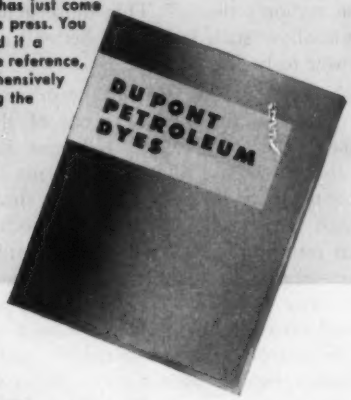
3. All possible opportunities should be utilized to



NEW DU PONT dye drumhead has an opening through which new probe can be readily inserted and manipulated. The two developments increase efficiency, save both time and money and eliminate dusting in the dry-dye eduction process.

This is a close-up view of special opening which accommodates dry-dye eduction probe. Opening can be resealed with standard 2-inch pipe cap.

THIS BOOK on Du Pont petroleum dyeing has just come from the press. You will find it a valuable reference, comprehensively covering the subject.



Here are two more big reasons to use Du Pont dyes

New probe: Only six months ago Du Pont introduced an eduction probe of revolutionary design. It greatly facilitated the dry-dye eduction process, and solved the problem of clogging.

Now the same engineers who developed the probe have developed a new drumhead, also radically different from the conventional type, reducing dusting to an absolute minimum.

New drumhead: The drumhead, though removable, need never be taken off. It has a 2-inch circular opening just large enough for insertion of the probe. The small plastic disc sealing the opening can be easily removed with a pocketknife.

The drumhead opening is rimmed with plastic which is threaded to accommodate a standard 2-inch pipe plug. That means easy resealing to protect the quality which is built into all Du Pont dyes.

Petroleum dye book: A comprehensive book on the whole petroleum-dyeing subject has just been printed. It includes solubility charts, spectrophotometer curves, data on latest dyeing methods, and the use of the new probe and drumhead described above. Copies of the book, "Du Pont Petroleum Dyes," may be obtained from any of the sales offices listed below.

Product quality: Du Pont petroleum dyes are popular throughout the industry because of their outstanding qualities . . . uniformity, stability, solubility, purity and strength. Colors include red, yellow, blue, orange and bronze. These can be combined to produce other colors.

All Du Pont dyes have been proved to give excellent results in greases, motor and heating oils, jet and diesel fuels—as well as in gasoline where they have been most widely used.

Technical service representatives will gladly give you further information on any phase of the subject of petroleum-products dyeing. They will also be glad to help you install a dry-dye eduction system to fit your requirements.

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stimulate scientific interest among presently employed non-technically trained persons through on-the-job training, and maximum degree of upgrading.

4. Industry's interest in educators should be broadened through all reasonable means to assist high schools, colleges, universities, and institutes in reaching their objectives. The oil industry has taken tremendous strides forward in this regard even to the extent of "loaning" experienced scientists and engineers to college teaching staffs.

5. Industry should work to encourage the entry into engineering and science training of more and more top quality young men and women, especially those of great ability who might otherwise be unable to secure the training. Industry should accordingly evaluate programs and plans to aid deserving students in furthering their scientific ambitions, such as underwriting tuition fees. This would help provide the 20 or 30 graduates per 1000 needed to meet the so-called deficit in Item 2, above.

Take an Organized Objective Look

If industry will but follow these measures, the shortage, if it really exists, can be solved. By all means, industry must not be panicked into any wild schemes which might destroy the goals of higher education or tend to emphasize quantity first and quality second. Industry and educators alike must take every precaution to see that the demand for numbers does not out-strip the demand for knowledge.

Scare tactics and over-emphasis of the problems must be cast aside. In their place, industry must take a broad-visioned look at the entire picture and come up with its own answers—on an organized, objective basis. This alone can eliminate narrow stop-gap measures and one shot programs that will only increase the problem.

Oil Price Hike May Be Near

HIGHER U. S. CRUDE prices are probably just around the corner. Disrupted flow of Middle East oil is resulting in a very tight U. S. oil supply. Crude stocks that had bordered on the excessive have been whittled, and are now only a little higher than adequate working levels. Several major purchasers already have raised their postings.

The U. S. is being called upon to supply about 800,000 barrels of additional crude a day as a result of the Suez Canal closure. Despite substantially enlarged production during recent weeks, this increased movement to Europe has caused heavy drafts on inventories. There is demand for more oil than can be moved to shipping ports by existing pipe line facilities. All this exerts pressure on oil price structures.

On the other hand, excessive stocks of gasoline still exist, although some improvement has been made in recent weeks. With heating oils in heavy demand during this season of the year and Europe wanting large volumes of this product, there is some fear that refiners will step up operations. That would result in the output of too much gasoline for this time of the year, and an opposing pressure on prices would take effect. This, of course, would hardly be beneficial to the over-all refinery products picture.

Another reason for the reluctance in boosting crude postings is the fact that the present heavy demand is temporary. It will ease with the Canal reopening. Under such circumstances a crude price hike might not be long maintained.

Some See The Light

OIL SEEMS TO BE getting a little better press lately. Some of it, no doubt, results from a policy of not biting the hand that fuels you, so to speak, now that the Suez Canal is blocked. Nevertheless, it was gratifying to notice favorabale comments recently in several papers.

The *New York Times* ran an editorial entitled "A Corporate Good Citizen" on November 18, 1956. It said "Standard Oil Company of New Jersey has once again given striking evidence of corporate good citizenship. Its financial support of higher education in this country is well known . . . it has made grants of over $1 million in the past year to American colleges and universities. Through its subsidiary Creole Petroleum Corporation it has organized the Creole Foundation in Venezuela . . . to promote cultural and scientific activities in Venezuela through fellowships and scholarships."

At least two Scripps-Howard newspapers, the *New York World-Telegram* and the *Washington News,* ran an editorial on December 1 entitled "The Payoff" praising conservation of oil and gas on the part of our state and federal governments which enables the U. S. to be in a good enough position oil-wise to export it to Western Europe in times of emergency. The editorial concludes ". . . The combination of a free oil industry, working with skill and imagination, of good conservation laws and far-seeing tax statutes, has paid off for America. Now it's paying off for our Western European friends, as well."

The *Journal of Commerce* of New York City on December 5 editorialized on "The Oil 'Monopoly' " which said, "We suppose that when men do come by the best of all possible worlds, necessities arising from the turn of events will still dictate that what was all right yesterday is wrong today. Or perhaps it will be the other way around, as in the case of the American plan for oil to Western Europe. A few months back, it would have been impossible . . . for in the view of the Department of Justice, the agreement would have been a clear violation of the anti-trust laws . . . In this particular case, the result may be a practical one. Congress, in turn, might consider whether the meaning of the word 'monopoly' ought to be made more clear. As the law is interpreted now, the Government is inclined to suspect that every company that is big is also bad . . . The moral climate of business might be improved if the law made plain—as the Government has done in creating this oil consortium—that every time two managements discuss pooling some resources they are not necessarily plotting to take over the nation's economy."

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ISOMERIZATION OF PENTANE-HEXANE FRACTION FROM COMMERCIAL STOCKS

	KUWAIT		MID-CONTINENT		NAT. GASOLINE	
	Feed	Product	Feed	Product	Feed	Product
TOTAL C_5-C_6						
Vol. %	100.0	97.3	100.0	96.7	100.0	99.2
Octane CFRR-Clear	63.7	77.7	62.1	77.0	72.3	83.3
+3 cc TEL	88.3	96.2	87.3	95.8	93.9	99.8
PENTANE FRACTION						
Vol. %	45.0	45.0	34.5	34.5	58.5	58.5
Octane CFRR-Clear	74.4	91.0	72.9	91.0	79.2	91.0
+3 cc TEL	95.8	104.9	94.9	104.9	98.4	104.9
HEXANE FRACTION						
Vol. %	55.0	52.3	65.5	62.2	41.5	40.7
Octane CFRR-Clear	54.9	66.3	56.4	69.2	62.6	72.2
+3 cc TEL	82.2	88.7	83.3	90.7	87.5	92.4

For more data on advertised products, use Readers' Service Cards, last page.

ISO-KEL

by M.W. KELLOGG

ISO-KEL is a new process developed by The M. W. Kellogg Company for isomerizing light naphthas. Designed to help refiners increase their high octane pool, ISO-KEL can upgrade combined streams of pentane and hexane fractions as well as natural gasoline.

One desirable application of ISO-KEL produces two separate products: (1) an isopentane stream of 104.9 CFRR+3 cc TEL, and (2) an isohexane stream of 89 to 92 CFRR+3 cc TEL, depending on the feedstock. When charging light naphtha, the combined streams have an over-all yield of 97 vol. % and an octane number of about 96 CFRR+3 cc TEL. When feeding natural gasoline, over-all yield is 99 vol. % and octane number about 99.8 CFRR+3 cc TEL.

The advantages of this new ISO-KEL process rest on a new, precious metal catalyst (not platinum) developed by M. W. Kellogg's research laboratories. This vapor-phase process requires only one reactor—which operates in the presence of hydrogen. Operating conditions are less severe than those for reforming heavy naphtha.

Economic soundness of the ISO-KEL process is illustrated in the case of a 50,000 BPD refinery, where a 3,100 BPD ISO-KEL unit would have a payout of about 19 months. Write for further economic and technical data.

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FIGURE 1—Author J. L. Risinger uses air agitation to bring oil, not heated to its flash point, to the surface. This is one of three methods which can be used to put out a fire by breaking up the correct vapor-air mixture. Other methods include reducing the air content below that required, as with CO_2 or dry chemical, and reducing the vapor content below that required, as with foam, which blankets the surface.

FIGURE 2—In this 30-foot diameter tank containing Mid-Continent crude oil, the heat wave is in progress as the light ends are burning off and the heavy ends are sinking.

Safety and Fire Protection—Part I

How Oil Acts When It Burns

In beginning this timely series, one of the nation's top authorities on safety and fire protection outlines the fundamentals of this vitally important field.

J. L. Risinger
Maplewood, N. J.

EFFECTIVE FIRE PREVENTION and fire fighting depend on two important factors:

- Knowledge of the conditions under which a substance will ignite.
- Knowing how the substance burns once it is ignited.

All substances have certain common characteristics—they burn only when converted to vapor or broken up into finely divided particles and mixed with oxygen in some form and correct volume proportion. In all but a few rare cases, oxygen comes from the air.

Oil and its products can burn only when the flames are fed by vapors from it, mingling with oxygen in the air in the correct volume percentage. This supports the belief that there is only one way to put out a fire. That is

by breaking up—throwing out of balance—the volume percentage ratio (see Figure 1).

In the case of oil and its products, the percentage range of vapor in air is narrow, thus it can be unbalanced easily to prevent ignition; and if burning, may be more easily unbalanced to extinguish the fire.

However, the problem of fire extinguishment is complicated by the fact that no two crudes have the same volume percentage ratio, due to differing physical characteristics. In fact, crude oils have only one thing in common—they are all made up of a variety of hydrocarbons. The chief guide for grouping these hydrocarbons is their boiling points, boiling ranges, flashpoints and vapor pressures.

Since no two crudes have the same characteristics, each

FIGURE 3—In this small crude oil tank, the heat wave has reached the water at the bottom of the tank and the steam explosion is throwing some of the oil out.

type crude presents a different fire problem. To better understand the burning characteristics of an individual crude, it is essential to have a working knowledge of the following physical characteristics:

1. Initial Boiling Point. The temperature in an open container at which the lightest hydrocarbons will leave the mass of oil at sea level atmospheric pressure (boil-off) as a vapor.

2. Final Boiling Point. The temperature at which the heaviest hydrocarbons of the crude will vaporize. As most crude oils have a final boiling point higher than their ignition temperature, tests of the final boiling points have to be obtained in vacuum.

3. Boiling Range. That range of temperature from lowest to highest during which all fractions of differing gravities and boiling points will be converted to vapor or gas. Crude oils of lowest flash points and still containing their heaviest and less volatile fractions would therefore have the widest boiling ranges.

4. Ignition Temperature. The lowest temperature of a sufficient volume of heat required to ignite the vapors

FIGURE 4—Crude oil boilover without fire. In this demonstration the tank without water in the bottom was burned until the heat wave reached the bottom. The fire was then extinguished with dry chemicals and the water pumped in so that the oil being thrown out could be observed better.

from a specific oil, or the finely divided particles of a specific substance when these are in a correct mixture with air, known as their burning ranges. Note: Since each hydrocarbon or petroleum mist droplet must be surrounded by air to be within their burning range mixture, the volume of heat must be sufficient to ignite not only one, but group of sufficient size to produce a flame. The flame must be of a size that will bridge the air gaps and propagate through the quantity of suspended vapors or mist.

5. Fire Point. The lowest temperature at which an oil will give off vapors sufficient to burn continuously at its surface for at least five seconds after it is ignited. In some oils the fire point is only five degrees F above the flash point, and in others it is much higher.

6. Flash Point. The lowest temperature at which an oil will give off vapors sufficient to form a flammable mixture with air that will flash across the surface when ignition temperature is applied. Flash point is determined under controlled laboratory conditions and is usually below the burning temperature of the liquid. The term "high flash point" is used to describe an oil with a flash point above its ambient and/or stored temperature. The term "low flash point" is used to describe an oil with a flash point below its ambient and/or stored temperature.

7. Explosive Range. All concentrations of a mixture of flammable vapor or gas in air (usually expressed in per cent by volume of vapor to air) in which a flash will occur or a flame will travel if the mixture is ignited. The lowest percentage at which this occurs is the lower explosive limit. If a mixture in the explosive range is confined and ignited, an explosion results. Note: The normal explosive range of gasoline is from 1 percent to 6 percent vapor and from 99 to 94 percent air by volume.

8. Ends, Light. That group of hydrocarbons compos-

ing the first few of the lowest boiling points of the boiling range of an oil.

9. Ends, Heavy. That group of hydrocarbons composing the last few of the highest boiling points of the boiling range of an oil.

10. Specific Gravity. The ratio of the weight of equal volumes of a substance and water. As applied to oil products, it is customary in this country to take the weights of both the oil and of the water at the temperature of 60 F. The specific gravity, therefore, is usually designated as "Specific Gravity at 60/60 F."

11. API Gravity. The API gravity of an oil is a mathematical function of the specific gravity as defined above. The relationship is defined by the following equation:

$$\text{Degrees API} = \frac{141.5}{\text{Sp. Gr. } 60/60^\circ \text{ F.}} - 131.5$$

Some crude oils may contain a few light ends and a few middle boiling range hydrocarbons, but they are chiefly composed of low API gravity and high boiling point hydrocarbons. Therefore, a low API gravity crude oil may also have a low flash point. Most often, however, a very low API gravity crude oil has a high flash point.

12. Vapor Pressure. The tendency of a substance to vaporize, generally expressed in terms of millimeters of mercury or pounds per square inch, absolute. Vapor pressure of a liquid at its boiling point is equal to the ambient atmospheric pressure, on the absolute scale Reid vapor pressure is calculated on the basis of the specific oil at a temperature of 100 F.

It is sometimes though that the lower the flash point of crude oil, the higher is its vapor pressure. This is not necessarily true. A crude oil with but few very light hydrocarbons may have a very low flash point and also a low vapor pressure. The rule does hold good, however, in the case of high flash point crude. This usually has practically no vapor pressure or not sufficient to provide a vapor above the liquid in an ignitable state.

HEAT WAVE CHARACTERISTICS OF CRUDE OIL

Crude oil fires, like refined oil fires, are extinguished by unbalancing the required proportion of air and vapor that is forming the burning mixture. However, the reaction of some crude oils to heat input from surface burning in tanks and pools known as their heat wave establishing characteristics may require a different technique in application when water or foam is to be used.

Let's suppose that a crude oil cone roof tank has been ignited and all or part of the roof is off so that the vapors above the surface can mix freely with air in burnable ratio and are burning freely. What is happening? (Figure 2—30-foot tank burning.) The heat is now above the liquid. The surface of the oil is being heated. The high gravity low boiling point hydrocarbons are leaving the surface and mixing with air. They are forming the fuel that feeds the fire.

Continued on Page 259

Why A Series on Fire Protection?

WHENEVER IN history the technology or know-how of safe control of a force or power and the training of people to use the safe controls have lagged behind the development of this force, it has become hazardous to man and obtained a bad reputation as such. Up until a few years ago, this seems to have prevailed in the case of petroleum and its products, in its production, storage, handling and use. It still prevails in some cases and at some locations today.

Some companies are spending considerable money in safety and fire protection engineering and training to progress this phase of their business and responsibility. However, the companies that are spending the most money in this field have not necessarily accomplished the greatest results. Why? Because of the placing of too much emphasis on possibilities that have become remote by progress in development of machinery, construction and equipment . . . and not enough attention to evaluating these possibilities in the light of modern progress.

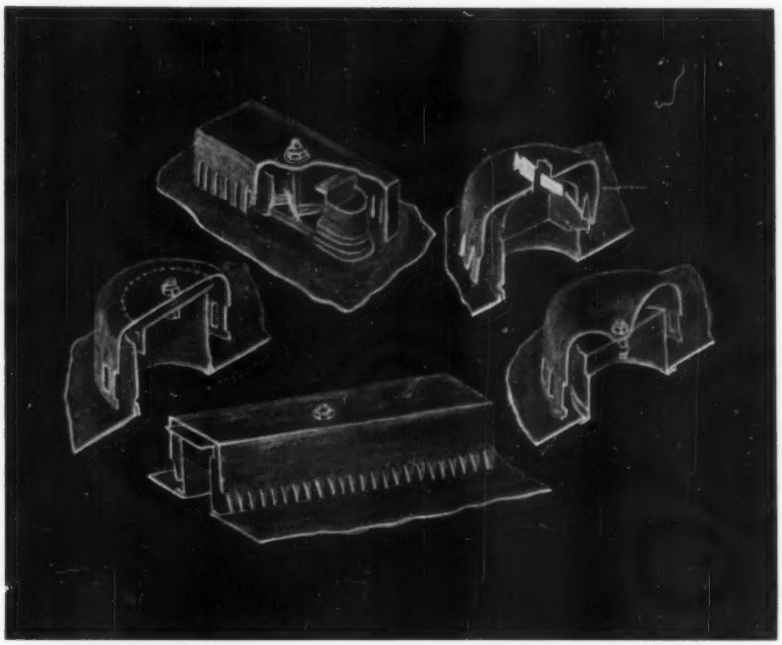
In the case of fire protection, an oil company cannot afford to spend the money necessary to prevent all fires, nor to provide systems that would readily extinguish every fire that occurs.

This brings into the picture the proposition of the graded risk. Graded risk cannot be considered where the lives of people are involved. It can be considered where the cost of the loss of property from fire over a period of time would be many times less than the cost of the provisions for prevention of the fire, the possibility of its occurrence sometimes being very remote or nil, and/or the provisions for the ready extinguishment of these fires, the incident of which are nil or very, very infrequent, or the total cost of the loss of the property would be less than the cost of prevention or extinguishment. This graded risk calculation is taken into consideration in the first three articles in this series.

Special characteristics which give crude oil its heat wave establishing, boilover, and slopover qualities will be defined, described and illustrated. On the basis of these characteristics, modern and new methods of preventing these fires will be defined, described and illustrated. And finally, on the basis of these characteristics, modern and new methods of control and extinguishment under field conditions that may be encountered will be defined, described and illustrated.

Other articles in the series will include "Preventing Lightning Ignition of Floating Roof Rim Fires," "Safe Handling and Storage of Jet Fuels," "Fire Protection on the Graded Risk Basis," "Control of Liquefied Petroleum Gas Fires," and "Safe Storage of High Vapor Pressure Products."

Special MAINTENANCE Report



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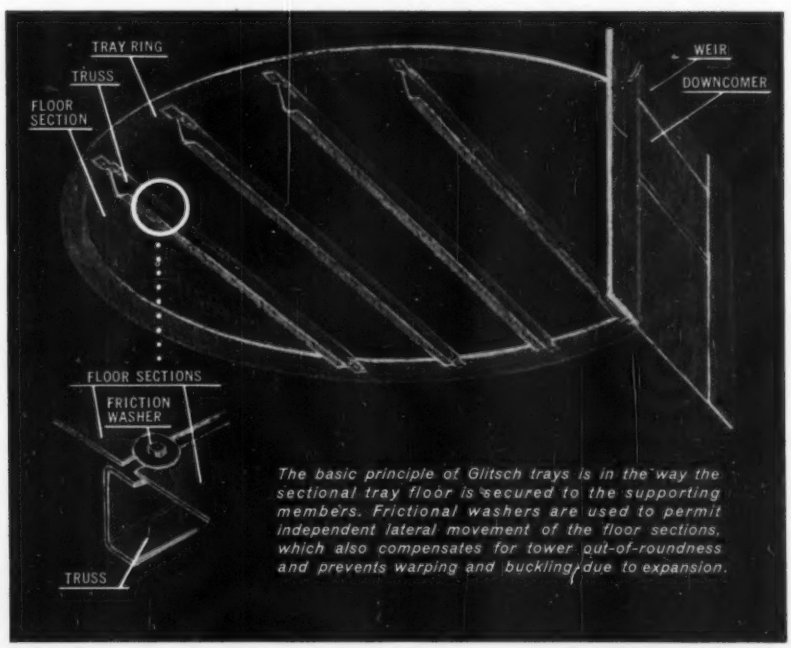

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Below the Rio Grande, near Reynosa, in Tamaulipas, Mexico, Petroleos Mexicanos has recently completed this major gas processing project designed to process 300 million cubic feet of natural gas daily gathered from numerous fields within an area of about 400 square miles. About 8,000 barrels per day of fractionated products, including propane, butanes, motor fuel, naphtha and kerosene will be produced.

Engineering design and procurement of equipment was entrusted to Hudson, and the satisfaction of our client is attested by a current contract for a similar but even larger project for Petroleos Mexicanos on the Isthmus of Tehuantepec.

DESIGNERS AND CONSTRUCTORS OF
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HUDSON
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THEY HELPED PLAN THIS ISSUE. The 1957 Maintenance Issue editorial conference was held to establish the limits and type of editorial content for this issue. Attending the conference were the industry experts shown at right, left to right: Ray Shannon, James P. O'Donnell, Engineers; V. B. Volkening, Dow Chemical Company; Jodie Isenhower, Humble Oil & Refining Company, and F. D. Macy, Shell Oil Company.*

Maintenance Issue '57

THE 1957 MAINTENANCE ISSUE marks another banner edition in this annual compilation of maintenance articles for the refining, petrochemical and natural gasoline industries.

Within the last few years, modern cost analysis techniques have revealed that maintenance requires more dollar expenditures than any other refinery operation. For the year of 1957, it has been estimated by PETROLEUM REFINER's market research department, that the worlds refining-processing industry will spend in excess of $1.5 billion on labor and materials for maintenance of their plant facilities. This amounts to $4.5 million per day. Sixty percent of which will be spent in the U. S.

Since nearly half of all refinery, petrochemical and natural gasoline personnel are employed for maintenance operations, this vital plant function is of concern to every refinery man.

New equipment, techniques and organizational setups are constantly being devised to hold this dollar-consuming giant in check. This is PETROLEUM REFINERS format—to bring to maintenance men in the industries plants all of the ideas that will provide a means to reduce maintenance costs.

Frank P. Evans Jr.

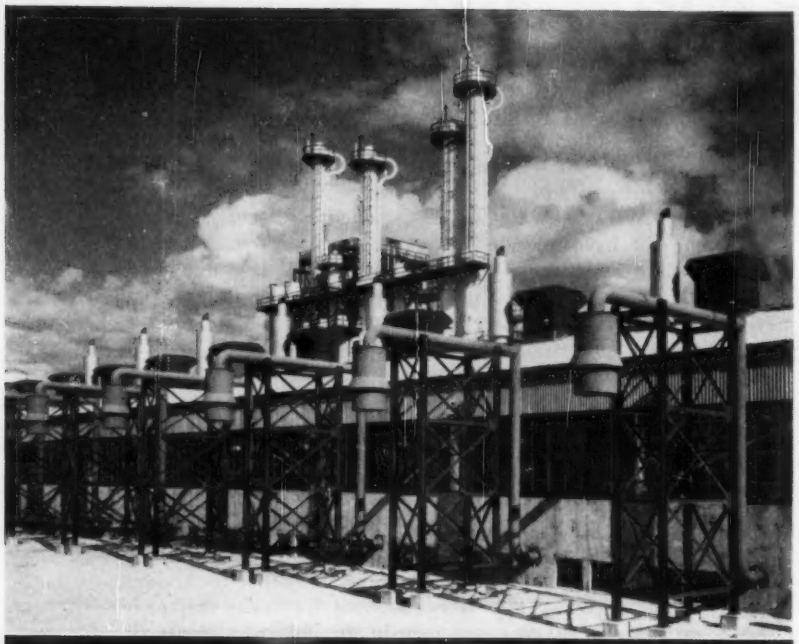
* The attendance by executives, engineers, superintendents or other employes of oil companies at these editorial conferences does not constitute an endorsement of the REFINER or any other publication. The fact that these industry leaders are allowed to attend the planning conferences shows the interest which companies have in the planning of sound editorial content for the industry.

Contents

Color Can Revolutionize Your Plant 120
New Ways to Reduce Painting Costs 125
Organize Your Painting Program 129
Maintenance Must Be Planned 132
Does Inspection Increase Costs? 133
Maintenance Must Grow With Your Plant 135
Are You Caught With Your Stock Up? 139
How Esso's Mechanical Department Works 143
Keep Inspection Records the Easy Way 147
Use Water to Clean Your Steam Turbines 150
An Ounce of Preventive Maintenance 151
Select and Maintain Expansion Joints 155
How to Maintain Steam Traps? 161
Centrifugal Pump Packings and Seals 163
V-Belt Maintenance 167
Intergrate Major Revamps With Turnaround 169
Ways to Improve Instrument Maintenance 171
Maintenance Costs Drop 174
New Ideas in Preventive Maintenance 175

MAINTENANCE

Color Can



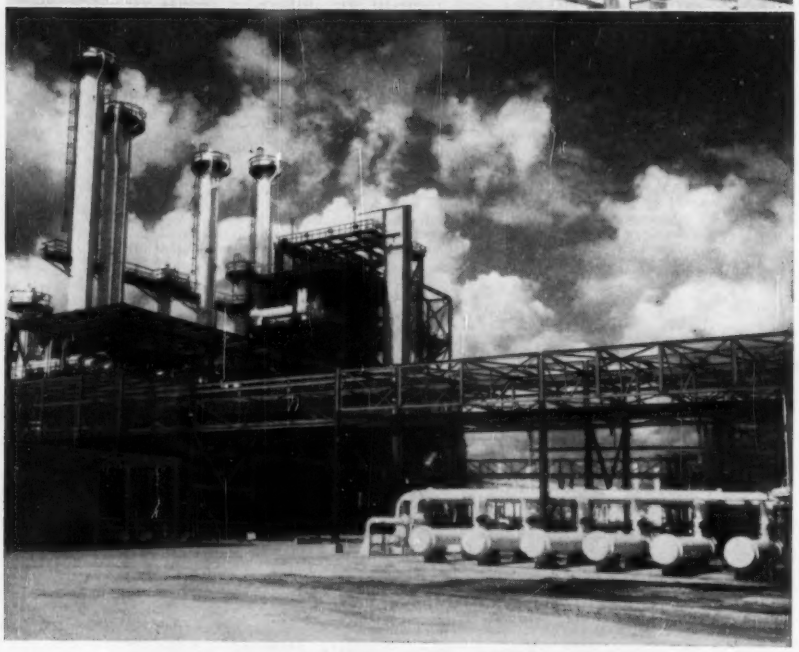


FIGURE 1 (Top)—It all began with pipe lines painted blue-green and structures vermilion.

FIGURE 2—"Mass coloring" eases the old rule and blends structures and pipe to prevent harsh contrasts. Pipe racks (not shown in color) are blue-green.

R. H. Bacon and V. B. Volkening
The Dow Chemical Company
Freeport, Texas

FROM A DISTANCE, the scene is something like peering through a kaleidoscope: the colors are vermilion, blue-green, gray, white, and aluminum, spotted in large and small patches throughout the scene. The site is Dow's Texas Division, located in an area which, just 16 years ago, was an ocean of salt grass grazing land.

But there is a subtle, if important, difference. A kaleidoscope's colors fall into place simply by chance. The colors that are spread over the division's towers and tanks and piping are there by design.

The practice of color painting was born early in the history of the Texas Division, partly for beauty but for other purposes too. Behind the planning was the simple theory that each color had its place, depending on the particular set of circumstances involved.

Originally, this theory was carried to an extremely fine point, with the result that all pipe lines were blue-green and all structures vermilion. Even pipe hangers and knee braces on tanks were painted in contrast to the adjacent surface. Figure 1 illustrates this philosophy.

As the plant grew older and larger —and maintenance costs became a more predominating factor—the color scheme was relaxed to an extent. The

Revolutionize Your Plant

Use the "Mass Color" system in your plant and watch the increase in safety, pride and morale.

practice of painting units or portions of units in "single color" patterns became the standard, with only a few items painted for contrast. The result—called "mass coloring"—is typified by the pipeways, structures and columns in Figure 2.

However, some need was still felt for painting for code purposes and for identification. This is practiced for both convenience of operating plants and maintenance departments. Personnel sometimes need identification, too, and this is accomplished with vari-colored safety hats.

As for the division's safety program, too much cannot be said in favor of the use of color. Safety showers, eye wash fountains, man elevator hoods, to name some examples, are painted in colors that show up well. A typical safety shower and eye wash fountain is shown in Figure 3.

There is also the matter of general plant housekeeping to consider. A well-painted, colorful plant is usually a clean one, and the practice of painting various hard-to-keep surfaces white lends weight to this axiom. Figure 4 is an example of colors as they contribute to good housekeeping.

The final touch in carrying out a plant-wide color scheme is in bright, clean colors for offices and laboratories. Personnel are offered a choice of eight harmonizing color schemes for offices and laboratories by way of adding personal touch and a feeling of having had a part in the painting program.

Blue-green and vermilion are the basic and predominant colors throughout the division. Blue-green is used on tanks, columns, heat exchangers, and the like, while vermilion is used on such items as structures and pipe supports.

In alkaline areas, gray is used almost exclusively. However, vermilion is used as a sharply contrasting color on handrails, ladders, and ladder cages.

Colors also serve a functional purpose in many cases—i.e., whites are utilized for heat reflection. Their use on tall insulated columns with red ladders and platforms makes for an eye-catching scene as you approach the main entrance of Dow's Plant A. White is also used to promote cleanliness and in dark corners for light reflection.

Other examples of functional coloring is the battleship gray that is used for identification of the government-owned magnesium facilities, and the international orange and white on water and micro-wave towers, according to CAB regulations. And two old reliables, black and aluminum, may also be found—aluminum on exhaust stacks and black in extremely corrosive areas for economy reasons.

Centralized Responsibility for Color System—Each production unit is relatively autonomous. However, since the selection and control of colors for the entire division is a top managament function, this particular planning is somewhat anti-

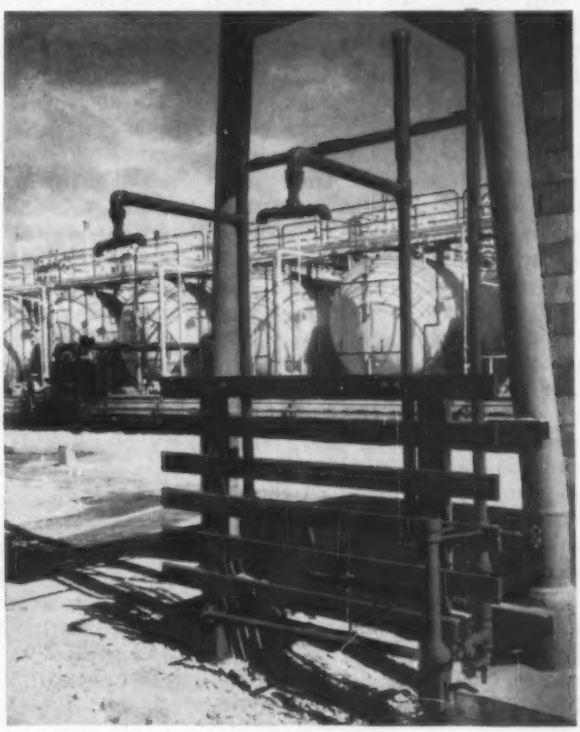


FIGURE 3—Safety showers and eye wash fountains are painted red so that they show up well.

Color Can Revolutionize Your Plant . . .

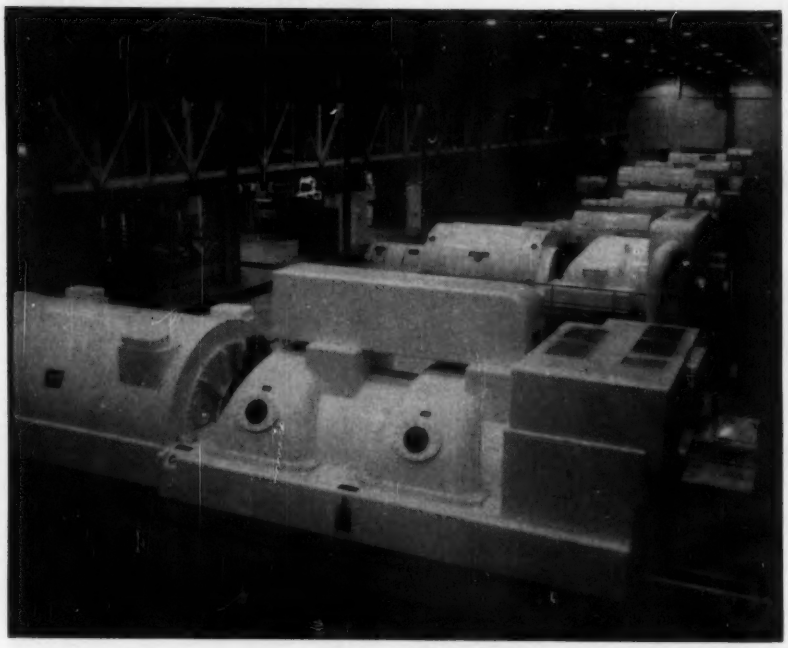


FIGURE 4—Clean white for plant interiors produces good housekeeping.

thetical to production operations.

The color scheme originally was selected by Alden B. Dow, architect, and member of the Dow's Board of Directors. Since its origin, some changes have come about for several reasons—among them improved durability, economy, and brighter, cleaner, safer work areas. A central group—the division's paint committee—has the responsibility for control of the general plant painting policy.

The paint committee was established to represent all interests through its nine members: construction, engineering, maintenance, operations, purchasing, research, and services. Authority is reinforced by the paint manual now in its third revision since it was first issued by the committee in 1948. In addition to color specifications for everything that is painted in the division, the manual also lists each type of paint used and its source of supply. These specifications, incidentally, are based on actual performance testing and evaluating of proprietary and special products of companies trying earnestly to help solve specific problems.

The reasons behind this system might be best explained by example. Say, for instance, that a chemical plant were painted only one color. Obviously, only one decision relative to color would be necessary: the selection of the particular shade.

But in a plant where many colors are used, many more decisions are necessary. The responsibilities for control of the color program logically is centrally controlled for the sake of uniformity, economy, and minimum inventory of paint stocks. However, individual likes and dislikes are resolved within the limits of the paint manual.

Of greatest importance in the central authority for color selection, probably, is the necessity for stable shades of standard colors in a variety of atmospheres. There is an awareness of the poor color stability of certain colors, even under ordinary atmospheric conditions. Some shades of green may be changed to blue with minute traces of chlorine or oxidizing conditions. However, a vermilion color may be pigmented from a variety of pigments and one has been especially outstanding over the years.

In the production of acids, alkalis, metals, solvents, and many chemical intermediates, many different conditions are encountered that are corrosive to steel and deleterious to coatings. As a result, the selection of coating types as well as colors becomes essential. The color is at present limited to black because thick mastic coatings of asphalt and coal-tar are required for corrosion control in certain processes with a high rate of corrosiveness. But with the progress being made in some of the most chemically inert, newer resin types (epoxies, polyesters, vinyls, etc.), this color limitation may soon be overcome.

Costs Studied—The question of maintenance costs usually receives careful scrutiny by management. Also under consideration recently has been maintenance versus replacement costs.[1,2]

In any given environment, many factors go into the determination of durability of coatings. This necessitates the selection of the proper coating for each specific job—a decision that means durability, applications characteristics, cost, availability, and other factors must be taken into account for a specific job in a given environment.

Experience has shown the durability of certain colors in comparable resin type finishes has been consistently better than others. The following is a comparison of the colors commonly used, ranked in decreasing order of merit according to durability:

- Black
- Vermilion
- Blue-green
- Light Gray
- White
- Aluminum

The life of black or vermilion may be more than double that for aluminum. These results are based on exposures over a period of years in an area of high corrosion[3] that results from process vapors and high humidity. Because of the necessity of protecting steel in such areas, particular attention must be paid to the selection of the more chemically inert resins.

For the sake of comparison, Table 1 has been prepared in which costs of conventional enamels (alkyds, phenolics, vinyl toluenes, etc.) have been compared with the more alkali and acid resistant chlorinated rubber and vinyl coatings. The relative costs were obtained by calculating the comparable cost[4] for the several materials with which we have had the

most experience and success over the years. Comparable cost is calculated from the following equation:

$N = W/16.04\ V$

N = Comparable paint cost, cents/mil Ft^2

W = Paint Cost, dollars/Gal

V = Solids by Volume, fractional gal.

The relative cost was determined by assigning the value of unity to paints having the lowest comparable cost (conventional black enamels). All others were then divided by this lowest comparable cost. Each figure in Table 1 is the average of several products.

The observations apparent from this table are:

- Colored paints, such as blue-greens and vermilions, are more expensive, (by 5 to 30 percent) than blacks, depending upon resin types.
- The cost of chemical resistance is of greater magnitude than cost of color. Compared to the conventional enamels, the chlorinated rubber coatings average approximately 65 percent more and the vinyls 220 percent more.

It should be emphasized when comparing the cost of colored finishes, we are generally concerned with only the final coat and not the complete three, four or more coats in the system.

Why? Because black or gray may be used for contrast between primer and finish to promote more uniform, thicker, pinhole-free paint jobs. In the plant, the contrasting color under the final finish of blue-green or vermilion over two primer coats of different shades is generally gray.

Since material cost may amount to only ¼ to ⅓ of the cost of a given job—in highly corrosive areas, the life of the chemically resistant coatings may be 50 percent greater than the conventional enamels. The material prices should not be considered alone and apart from the applied cost. However, a neat job is always demanded, and this means that only one color can ordinarily be sprayed, and that the other colors must be carefully "cut in" by use of a brush. Other cost factors are cleaning equipment, loss of time while changing colors, to name two of the major items that increase the cost of a multiple color scheme.

A comparison of the labor cost of the present color scheme in the Texas Division has been obtained from competitive bids for applying conventional enamels on several large jobs having different color requirements. The conclusions are presented in Table 2.

The figures in Table 2 indicate that if one goes the full distance on color painting, the added application cost could rise as high as 25 percent. However, satisfactory color contrasts can be maintained with "mass coloring." By reverting to a single color the application cost could be reduced by perhaps 7 percent.

Table 3 contains comparison of four different types of coating systems exposed in a corrosive area with service cost that is based on the actual life of each system. Indicated quantitatively in a similar manner to Tables 1 and 2 are the relative paint maintenance costs.

The initial cost is based on the

Here Are the Facts About Color Painting

• The most economical use of multi-color painting in a chemical plant involves the use of a "mass color" system.

• Within the colors of Dow's plant, the most expensive colors (vermilion and blue-green) may be as little as 5 percent or as much as 30 percent more than comparable products in black.

• The cost of corrosion prevention by means of acid and alkali resistant chlorinated rubber and vinyl coatings is of much greater magnitude than the color—with chlorinated rubbers 65 percent more and vinyls 220 percent more than conventional enamels.

• Color painting adds safety, good housekeeping, pride and morale advantages for which no dollar assignment is possible.

TABLE 1
Average Relative Costs of Finishes

	Vinyls	Chlorinated Rubber	Conventional Enamels	Average (Colors)
Vermilion	3.73	2.12	1.31	2.39
Blue-green	3.69	2.08	1.19	2.32
Light Gray	3.56	1.69	1.10	2.18
White	3.48	1.75	1.06	2.10
Black	3.52	1.79	1.00	2.10
Average (Resins)	3.60	1.89	1.13	....

TABLE 2
Comparison of Application Costs for a Multiple Color Scheme

Color Scheme	Relative Cost
Single Color	1.00
Mass Color Contrast	1.07
Strict Color Contrast	1.14
Strict + Coded Process Lines	1.25

TABLE 3
Comparison of Initial and Service Costs of Different Systems—Relative Costs

Coating Types	Initial	Service	Available Colors
Bitumens	1.60	1.00	Black
Chlorinated Rubber	1.07	1.12	All
Vinyl	1.35	1.42	All
Conventional Enamels	1.00	1.57	All

Meet the Authors

R. H. BACON is a member of The Dow Chemical Co., Texas division, Freeport, Texas. As a group leader, his duties involve materials evaluation, and research in the fields of corrosion and materials of construction. Bacon graduated from the University of Texas in 1937 with a B.S. degree in chemical engineering. Shortly after graduation he joined Duval, Texas Sulphur, then two years later went to work for Dow. He is a member of numerous technical societies.

V. B. VOLKENING is a staff specialist for The Dow Chemical Co., Texas division, Freeport, Texas. His duties involve evaluation, specification, and economics of painting, and also specifications on roofing. He has had experience as a painting contractor, and as superintendent of painting for Dow at Freeport. Bacon has taken short courses in industrial engineering from I.C.S., management from Southern Methodist University, and spray painting from DeVilbiss Co. He is a member of N.A.C.E., and Coating Society of America.

applied cost per unit area. The service cost is the cost per unit area per unit of time; a cost for which the lowest possible figure is sought. If color rather than a black bitumen is desired, this may be applied after a period allowed for evaporation of the solvents from the bitumen. This, of course, means additional cost.

It is obvious that color painting can be done only at a premium, one that is determined by several factors:

- The extreme to which contrasting colors are used.
- The environment where the coatings are used.
- The life of the coating system in its environment.

Naturally, no dollar assignment is possible which includes all the advantages that occur from the area's brightened atmosphere. Safety and good housekeeping are also of prime importance.

At first thought, the special colors used might seem to add to the cost of color painting. Of the 44 colors in our color scheme, 28 items are manufacturers proprietary colors that actually represent a very small percent of our total volume. Much thought has been given to the possibility of converting to proprietary colors throughout the division, but careful investigation revealed no particular advantage. For one thing, volume methods of purchasing offsets the added manufacturing cost. A product designed to do a job is generally less expensive than one designed to meet a price. Quality is dictated by environment.

Effect on Community—As indicated, the high morale and obvious pride of personnel who work in a bright and colorful environment can be easily seen in improved housekeeping, safety, and attitudes during working hours.

In line with this, there is another point to consider: the atmosphere which, while being carefully encouraged during working hours, can grow into a real widespread community asset. It is reasonable to assume that a happy employe who has a colorful area in which to work also wants a colorful home. What is more, proof of this abounds in the gaily trimmed homes of many employes in this area. These homes attract attention and results in neatly kept places. It is also reasonable to assume that some of the Texas Division's ideas on color have spread to our industrial neighbors as well—again, to make for a definite asset to the general area.

Efficiency—Factors already mentioned—boosting of morale, better housekeeping, greater safety, and increased pride in our plants—obviously contribute to greater personnel efficiency.

As for the loss of products by vaporization, this has been adequately covered in the literature.[5,6] However, it should be noted that we also use considerable amounts of white for storage tanks, insulated vessels, and other equipment where absorbed heat causes loss of product or overheating. This generous use of white in most of our applications is for the dissipation of heat and consequent improved production efficiency.

Observations—There are few situations which cannot be improved, and that applies to some phases of our paint program.

For instance, vermilion, the brightest of the colors, which borders upon being a fire engine red, is probably held in the highest regard of any color used in the division. However, its brightness leaves us with little opportunity to make fire hydrants and other fire prevention equipment stand out as vividly.

Also, chalking of a color such as blue-green that is made from a combination of pigments, allows fading and discoloration. As a result, a single pigment color may have an advantage here.

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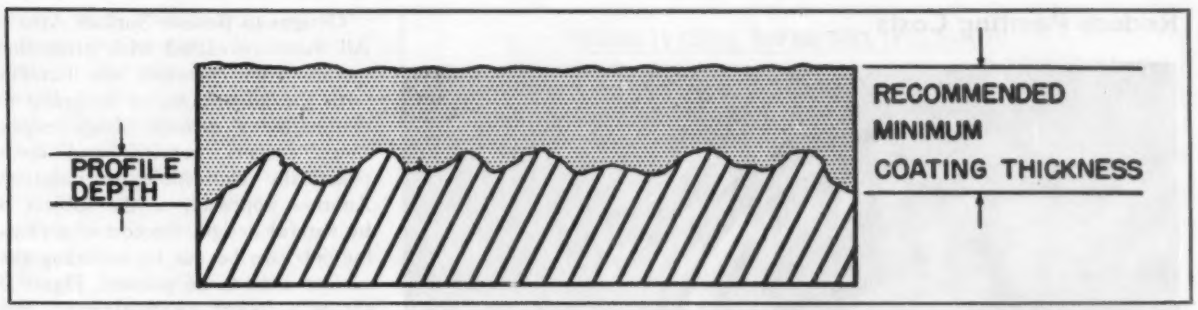


FIGURE 1—Illustrates rule for film thickness. Coating film thickness should be three times the surface profile depth.

New Ways to Reduce Painting Costs

MAINTENANCE

You can save 10 to 30 percent on a paint job by using these methods:

- **Design with less surface area.**
- **Tapes for auxiliary protection.**
- **Hot spray.**
- **High solids content paint with fewer coats.**

M. L. Monack, H. W. Shockley and J. R. Allen
E. I. du Pont de Nemours & Company
Wilmington, Del.

MAINTENANCE PAINTING represents a significant part spent annually on coatings to protect metal structures and equipment from corrosion. Since in many services coatings last only a few months, the first and most obvious approach in reducing maintenance painting costs is to take measures that will increase the service life of coatings. A second approach is to reduce the first cost of a protective coating job. This article will review briefly the requirements for obtaining long coating life and then follow in more detail with a discussion of the methods and materials for reducing first costs.

How to Obtain Long Coating Life

Proper Surface Preparation—Sandblasting is the best surface preparation method. Less effective compromise methods are dictated by economics, operating conditions, type of surface to be prepared and other considerations. It is always wise to remove mill scale, particularly for outdoor exposure. Subsequent popping of mill scale causes premature coating failures.

Proper Selection of Coating—Proper coating selection depends upon the type and severity of the service conditions. It is no problem to find a coating which is resistant to the weather, water and most chemicals; however, coatings have serious physical limitations. They are usually very thin, often porous and easily damaged. For this reason a coating should be used only as means to (1) extend the life of the substrate material which uncoated gives reasonable life, (2) reduce product contamination, and (3) improve appearance. It should never be used to protect a substrate material which is corroded rapidly by the environment —for example, steel handling hydrochloric acid. Under such circumstances it is necessary to use linings for protection or alternate materials of construction. Table 1 summarizes generally how coatings are selected and the results obtained.

Proper Application—The surface can be prepared as well as possible and the best coating system can be selected; but if the coating is not properly applied, a premature failure will result. This is caused usually by the presence of uncoated areas or pinholes in the film.

It has been determined that adequate film thickness is necessary to assure coverage over surface roughness, sharp edges and corners. A rule often used to determine the minimum requirements is that it should be approximately three times the profile depth of the surface roughness. For example, if the profile depth is 2 mils, then the dry-film thickness should be at least 6 mils. This is illustrated by Figure 1. By observing this requirement of film thickness, increased coating life will be obtained.

Workmanship is very important and it warrants considerably more attention. The electrical spark tester has been used for years as a check of workmanship for the linings and mastic type coatings on metals, but it

Reduce Painting Costs . . .

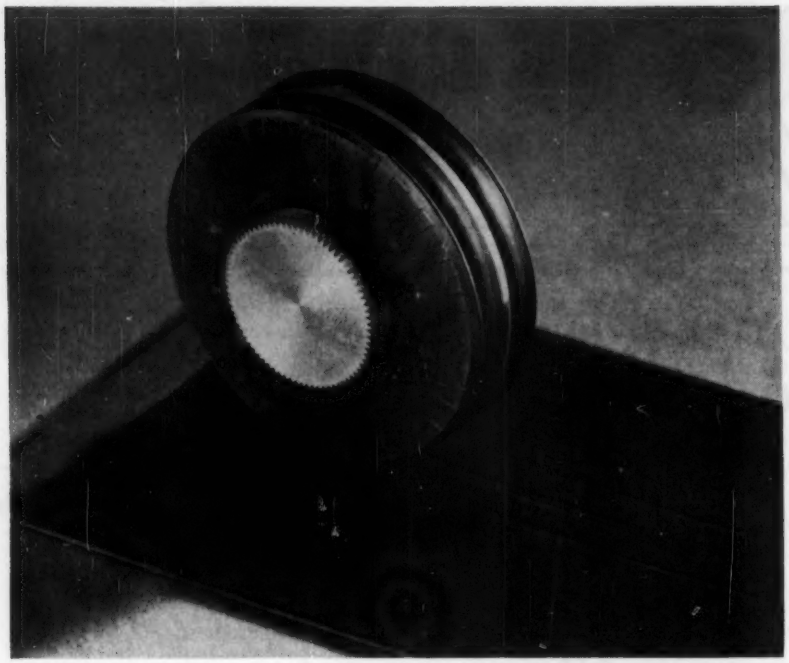


FIGURE 2—Wet-film thickness gauge which is used to determine film thickness.

has been only recently that a good wet sponge method has become available for checking the thin-film coatings.

One instrument which has been very helpful is the wetfilm thickness gauge pictured in Figure 2. It is simple to use and the painters enjoy checking each other's ability to get the desired film thickness.

Significant savings are being realized by following these principles. In severe services where maintenance painting costs were as high as 50 cents per square foot per year, they are now running, in many cases, between 5 cents and 10 cents. There has been a considerable improvement in the plants' appearance and failures of piping and equipment by corrosion from the outside are now relatively few.

How to Reduce First Cost of Coating Job

New developments and ideas have made it possible to reduce the first cost of a coating job. The percentage indicated varies from 10 to 30 percent, and this reduction applies for appearance painting as well as painting for protection.

A cost breakdown (Table 2) indicates that material and application labor account for roughly one-half the total cost. It is here that the first cost can be reduced. This can be done and is being done by:

- Using designs to reduce the surface areas to be painted.
- Using tapes as auxiliary protection.
- Applying coatings by the hot-spray method.
- Using coatings with a high solids content.

TABLE 1—Chart Showing Basis for Coating Selection

EXPOSURE	Corrosion Rate	Type of Protection	Film Thickness (Mils)	Average Life (Years)	Cost—Cents Per Sq. Ft. Per Year
Rural Atmosphere	Low	Oleo-Resinous Coatings	4 to 6	6	3 to 4
Fume Contaminated Atmosphere		Oleo-Resinous Coatings	6 to 8	4	5 to 7
Heavy Fumes		Asphalt Mastics	125	5	5 to 6
		Oleo-Resinous Coatings	6 to 8	2½	8 to 11
Splash or Spillage		Asphalt Mastics	125	Varies Considerably	Varies Considerably
		Plastic	8 to 10	Varies Considerably	Varies Considerably
		Neoprene	6 to 20	Varies Considerably	Varies Considerably
Immersion	High (.05 in./yr.)	Linings	60 to 250	5 to 10	30 to 60

Designs to Reduce Surface Area—All those associated with protecting metals from corrosion are familiar with the advantages of designing to eliminate or reduce sharp edges, sharp corners, crevices and areas practically inaccessible for painting. Another approach to the subject is by careful design, the cost of a coating job can be cut by reducing the surface area to be painted. Figure 3 shows several examples of this method. In each case the cost and structural properties were approximately equivalent.

Structural engineers consider it standard practice to use tees and WF beams instead of the back-to-back members, but there are times when the back-to-back members are advantageous functionally or they are used under pressure of circumstances. When they are proposed for use, careful consideration should be given to the disadvantages of greater area to be painted, more sharp edges, and foul areas.

Taping Technique—The use of tape as auxiliary protection with painting is practiced in many plants. In the severe services where four coats of paint are required to obtain sufficient film thickness over the sharp edges of structural members, the use of tape to reinforce the paint over edges reduces the number of coats required to two, which are sufficient to provide adequate film thickness over the plane surfaces. Savings up to 25 percent are obtained. Figure 4 illustrates the use of this technique.

Applying Coatings by Hot Spray Method—This is one of the most exciting developments in the field of maintenance painting. Engineers associated with maintenance painting first became interested in this method primarily for applying mastics. They were interested in obtaining a better flow-out, which, it was hoped, would reduce the number of pinholes in the overspray areas. It was soon found that not only was there better flow-out, but there was a better film build per pass, exceptionally good film build on sharp edges and the ability to

TABLE 2
Cost Breakdown of a Protective Coating Job

	Cost in Cents Per Sq. Ft.
Surface Preparation	10 to 15
Material	4 to 10
Labor, Application	5 to 10
Total	19 to 35

spray more satisfactorily outdoors during cold weather. It was found also that the material hose from the heater to the gun need only be ½ inch diameter instead of the normal 1 inch. diameter. This meant, of course, that a painter had much less weight and bulk to handle.

Time studies made on an application of mastics to several storage tanks by the regular method vs. the hot spray method showed that the application labor was reduced by 50 percent. This was accomplished because of the higher film build per pass and because the painter did not tire as quickly.

The natural reaction to the tremendous success of applying mastics by this method was to use it for applying the regular coatings. Accordingly, laboratory tests were made to determine whether any advantages were indicated. The results shown in Table 3 indicated definitely that higher film build per pass could be obtained with the vinyl, phenolic-tung oil and certain alkyd-linseed oil base coatings.

Figure 5 illustrates one of the advantages gained with hot spray. It shows two glass panels that were sandblasted and spray painted with a vinyl coating. Both applications were made by one pass with the spray gun, the one on the left with hot spray, and the one on the right with conventional spray. The bottom halves of the panels appear as they would normally be seen, and little or no difference is obvious. The upper halves are illuminated from the back by a strong light. We can see that with hot spray there are very few pinholes but with conventional spray there are many pinholes in the film. It should be emphasized that these are not complete coating systems but merely one pass with the spray gun.

Following the laboratory tests, field applications were made to determine whether any defects, such as edge

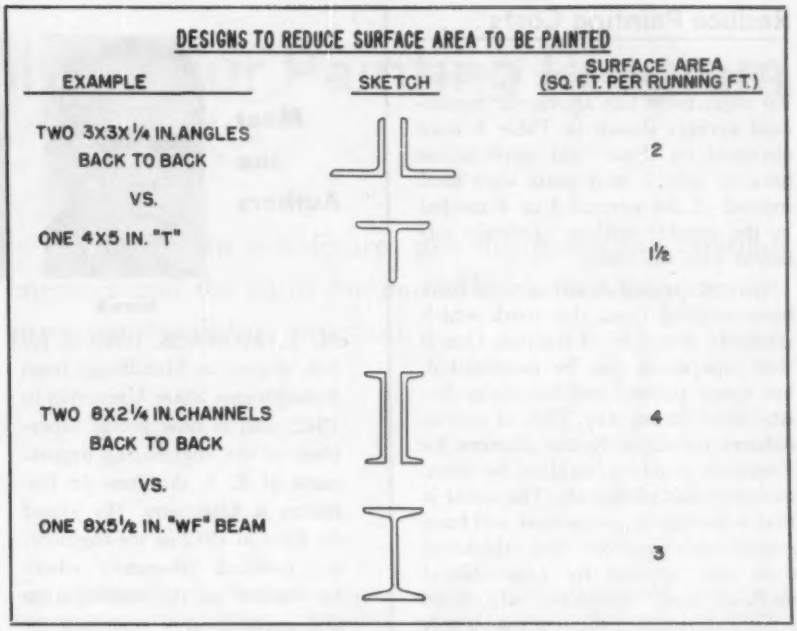


FIGURE 3—Cut costs by reducing surface area.

TABLE 3

Dry-Film Thickness of Coating Applied* by Hot Spray Versus Regular Spray Method

COATING	DRY-FILM THICKNESS IN MILS	
	Hot Spray	Regular Spray
Phenolic-tung Oil Primer A	4	2
Phenolic-tung Oil Primer B	2½	1
Phenolic-tung Oil Topcoat B	5	2
Alkyd-Linseed Oil Primer A	2	1
Alkyd-Linseed Oil Topcoat A	3½	2
Alkyd-Linseed Oil Topcoat B	1	1
Vinyl Primer A	3	1
Vinyl Topcoat A	5½	2

*One coat to maximum thickness obtainable without sagging when wet.

TAPE AS AUXILIARY PROTECTION WITH PAINTING
PROTECTION COST* IN CENTS PER SQ FT
TWO COATS PAINT & TAPE
20
FOUR COATS PAINT
28
*FOR AN 18 IN. BEAM

FIGURE 4—Tape reduces number of coats required.

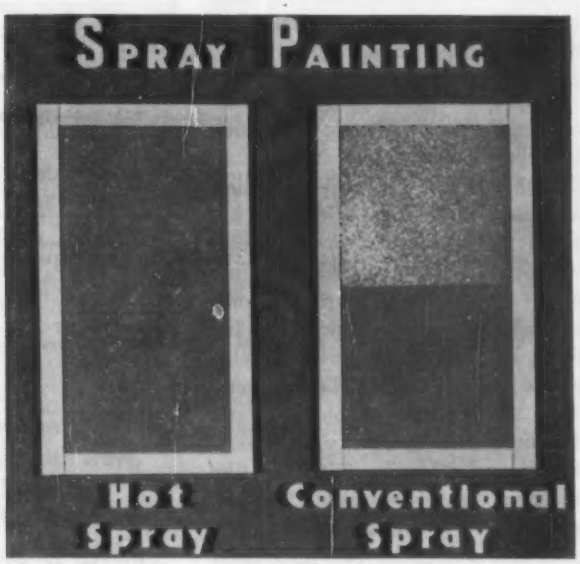


FIGURE 5—Hot spray method practically eliminates pinholes.

splitting, would develop in service. To date, none has appeared. Significant savings shown in Table 4 were obtained on these field applications because only 2 or 3 coats were used instead of the normal 3 or 4 needed by the regular method to obtain sufficient film thickness.

Several practical advantages have been realized from this work which probably would be of interest. One is that equipment can be sandblasted, hot spray primed and hot spray finish-coated in one day. This, of course, reduces considerably the chances for intercoat contamination by dust, moisture and chemicals. The other is that a hot-spray prime coat will have considerably greater film thickness than one applied by conventional methods and, therefore, will have greater durability. An example of this occurred at one plant where it is quite humid. A large amount of 6-inch pipe and fittings was stored outdoors. This material had been sandblasted and then painted with one coat of an oleoresinous primer, part by conventional spray and part by hot spray. After a period of one week, it was noted that the piping primed by the conventional spray method was covered with rust. The film thickness was checked and found to be 1½ mils. The equipment primed by the hot spray method showed no rust; the film thickness was 3½ to 4 mils. It was apparent that the conventional prime coat had inadequate film thickness to cover the peaks of the sandblasted surface profile.

High Solids Coatings—The numerous studies made on protective coatings have indicated that adequate film thickness is necessary to achieve a mechanical barrier. With most low solids paints, this requires, by conventional application methods, four or five coats, which are not only costly but often impractical. This has prompted manufacturers to develop paints with a high solids content. Products are now available which can deposit in one coat, a dry film thickness up to 10 mils. Adequate film thickness can be obtained, therefore, with only a two-coat application. The labor cost of applying two-three coats is thereby saved.

Meet the Authors

Monack

Shockley

Allen

M. L. MONACK received his B.S. degree in Metallurgy from Pennsylvania State University in 1942, and is now group supervisor of the engineering department of E. I. du Pont de Nemours & Company. He joined du Pont in 1942 in the engineering research laboratory where he worked on the investigation and application of materials for construction of chemical process equipment. In 1946, Monack became engineering materials consultant, and then in 1956 assumed his present position. He is also chairman of the protective coatings committee.

H. W. SHOCKLEY received his B.S. degree in mechanical engineering from Lehigh University in 1918. Shortly after graduation he went to work for Virginia Alberene Stone Company where he became plant engineer and assistant to the plant manager. For the past 29 years, however, he has worked for du Pont with five years in development and experiment, four years in maintenance, and the final twenty years in maintenance consulting. In his present position, Shockley is a consulting assistant where he aids all du Pont plants in improving maintenance performance.

J. R. ALLEN is research project engineer at the du Pont experimental station in Wilmington, Del., where he does research and development work in the field of protective coatings and thermal insulation. He received his B.S. degree in ceramic engineering in 1943 from Georgia Institute of Technology, Atlanta, Ga., then spent three years in the Army. Upon his discharge in 1946, he joined du Pont and spent the next eight years working on the research and development of non-metallic materials for the construction of chemical plants and equipment.

TABLE 4—Typical Field Applications of Regular Coatings Applied by Hot Spray

JOB DESCRIPTION	Coating System	Dry Film Thickness Mils	Elapsed Dry Time Between Coats—Hrs.	Application Labor Saved—Percent
Structural Steel and Equipment Exposed to Acid Fumes	Regular— 1 ct. Phenolic-Tung Oil Primer 3 ct. Phenolic-Tung Oil Topcoat	6 to 8	28	..
	Hot— 1 ct. Phenolic-Tung Oil Primer 1 ct. Phenolic-Tung Oil Topcoat	6 to 8	4	50
Structural Steel and Equipment	Regular— 1 ct. Alkyd-Linseed Oil Primer 3 ct. Alkyd-Linseed Oil Topcoat	6 to 8	72	..
	Hot— 1 ct. Alkyd-Linseed Oil Primer 2 et .Alkyd-Linseed Oil Topcoat	>5	48	25
Tank Car	Regular— 1 ct. Alkyd-Linseed Oil Primer 3 ct. Alkyd-Linseed Oil Topcoat	>5	72	..
	Hot— 1 ct. Alkyd-Linseed Oil Primer 1 ct. Alkyd-Linseed Oil Topcoat	>5	24	50

Original presentation at National Association of Corrosion Engineers Twelfth Annual Conference, March 12, 1956, New York, N. Y. ##

How to Organize Your Painting Program

MAINTENANCE

Two key figures are the protective coatings engineer and the paint foreman. Here's how they can improve your painting program.

Lew T. Gray
Phillips Chemical Company
Pasadena, Texas

NO PLANT PAINTING PROGRAM can be any better than the individuals actually conducting the work. The two key figures here are the corrosion or paint and protective coatings engineer and the paint foreman. If cooperation and team work cannot be created in these positions, there is every possibility that the painting program will fail. Certainly of almost equal importance is a crew of well trained, cooperative painters. The most carefully engineered paint system is doomed to failure if it is improperly applied.

The painting and protective coatings engineer is responsible for the selection of material and equipment, setting up and evaluating a paint test program, establishing and maintaining minimum and maximum warehouse stocks for paints. Annual scheduling, budget preparation and control fall in the scope of the paint and protective coating engineer's job. Additional responsibilities include initiating work orders which describe in detail the method of surface preparation, paint, and paint application to be used. Inspection and record keeping of each major paint project is a vital portion of this work.

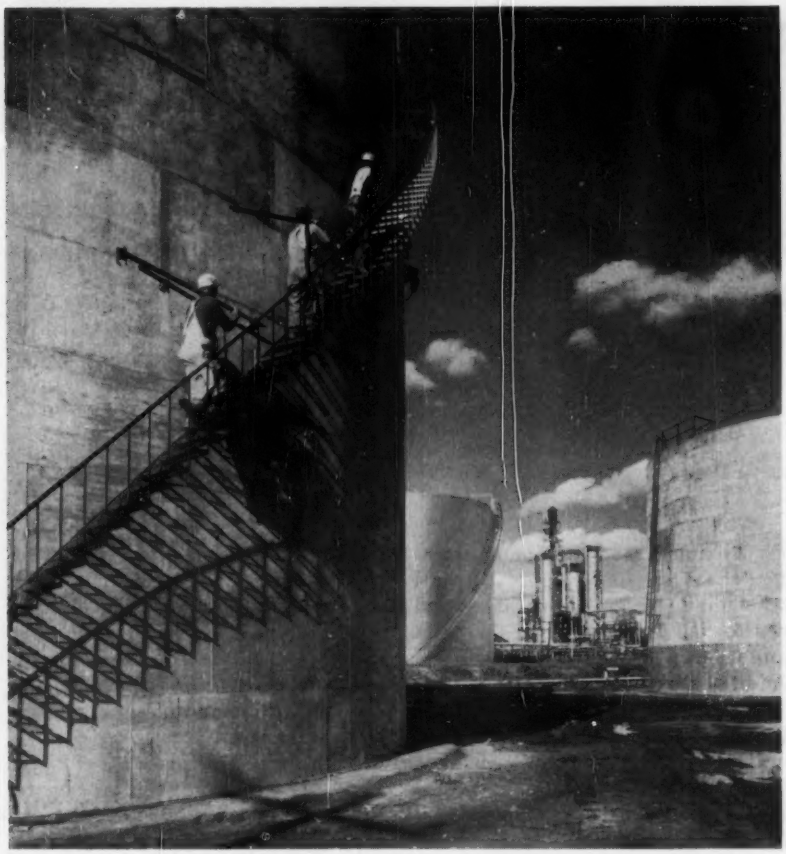
If real economy is ever to be achieved by a plant maintenance painting group, the foreman will be the key to success. Training the painters in each phase of painter responsibility, including paint application, surface preparation, equipment cleaning and maintenance, personal safety, scaffold erection, etc., is a clear cut responsibility of the Painter Foreman. Cost accumulations of labor and material for each job is the foreman's responsibility. Quality control and inspection are vital to the success of each job and must be handled by the foreman.

With the present high cost of labor, every consideration should be given to the use of labor saving equipment and tools. For example, in the Phillips Chemical Company, Adams Terminal plants, a substantial savings in sandblasting costs was realized through the use of larger sandblast hose, external hose couplings and venturi-tungsten carbide lined nozzles. An investment of approximately $8000 in buildings, tools, etc., is sup-

Painting Schedule Seeks These Advantages

- **A selection of both large and small jobs are available at the same time, thus permitting full use of the paint crew.**
- **Work is scheduled in adjoining areas giving the supervisor a better chance for work control and inspection.**
- **Allowance is made for unexpected rains by keeping a backlog of inside work available for those days.**
- **Inasmuch as is possible, every advantage is taken of the better summer months for painting. This includes adjustment of the size of the paint crew.**
- **Further advantage is taken by using contractors in addition to plant painters during the good painting season.**

Organize Your Painting Program . . .



No plant painting program can be any better than the men doing the work.

plied for each painter. This investment is represented by a paint shop, paint and sand storage warehouses, sand blast shed, portable air compressors, fresh air compressors, sand blasting equipment, spray hose and pots, paint heaters, brushes, mechanical cleaning equipment, scaffolding, ladders, bake ovens, paint mixers and shakers, tarpaulins and transportation.

With the variety of painting to be done in any large plant or group of plants, it is impossible to standardize on any one method of paint application; consequently brushing, spraying, hot spraying, rolling and dipping are used. Each method has its particular advantages and disadvantages. Brushing, particularly on prime coats gets the paint into cracks and corners that spray will not reach. Brushing also helps clean light dust, etc., from the steel and can be used outdoors when the wind prohibits the use of spray. Its primary disadvantage lies in the fact that brush application is much slower than spray application. Spray application, probably the most popular form of industrial paint application, is much faster than brushing. The appearance of a spray job is not marred by brush marks.

Hot spray application of some paints, especially the vinyl resin paints, has gained great popularity lately. The two principal advantages in hot spray application are increased paint thickness per coat and less overspray. Real economy can be gained here both from reduced labor (result of fewer coats to complete job) and in the decreased amount of solvent used. Roller application of paint is used for several industrial applications including tank farms, wire fences, office buildings, floors, etc. Roller application of paint leaves a good appearance, adequate film thickness and it is much faster than brush application in many cases. Dipping lends itself to the coating of small irregular shaped objects and its use is generally confined to the paint shop.

It would be difficult if not impossible, to set a hard and fast rule as to what method of paint application should be used for a given group of jobs, since so many variables influence the choice. Weather, type of surface to be painted, type of paint to be used, finish desired and even the skill of the craftsman all affect the selection of the most economical or satisfactory method of application.

Surface Preparation—Methods of surface preparation are even more varied than are the methods of paint application. Although there are a number of metals, alloys, woods, etc. that must have proper pre-painting preparation, this discussion will be limited to the methods employed on carbon steel. Sandblasting is perhaps the most popular method of surface preparation used in industry today. Although the initial cost of sandblasting is generally higher than that of the other methods, when the true cost of painting (cost per square foot per year) is considered, sandblasting is frequently the most economical means of cleaning. There are a variety of blasting materials including silica sands, flint, steel shot, synthetic grits, and grain hulls. Sandblasting is done with both dry and wet materials. The selection of the proper blasting material depends largely on what is to be blasted off the metal and the depth of the anchor pattern desired. The depth and irregularity of the anchor pattern greatly influence paint adhesion. Several patented, relatively new devices are available that not only blast the steel to the desired state of cleanliness, but by means of a vacuum and a container, the grit, dust, rust and old paint, etc., are separated and the grit reused thus giving a dust free operation. This method of cleaning, though much slower than conventional sandblasting, lends itself exceptionally well to cleaning in areas where dust cannot be tolerated. Work around electrical equipment and exposed mechanical equipment, fans, open reaction vessels and in areas where product contamination is a problem are ideal spots for this method of cleaning.

Hand cleaning by means of suitable wire brushes, scraping devices, emery wheels and sand paper all have their place in industry. Phillips has realized

considerable savings by combining hand cleaning with phosphatising. Phosphatising is a process involving the use of a weak phosphoric acid solution with suitable wetting agents. These solutions react with rust to form iron phosphates which seem to increase paint adhesion and reduce paint failures caused by painting over rust. It might be mentioned here that the selection of the proper phosphatising solution is extremely important since many of the materials tested caused more harm than good.

Planning and Budgeting—Toward the latter part of each year, the succeeding year's paint budget is made up. This is done by the Paint and Protective Coatings Engineer. This paint budget includes all major expenditures for painting with a suitable allowance for miscellaneous painting to be done throughout the year. It is interesting to note that the annual painting cost averages approximately 0.5 percent of the total plant investment. This is probably higher than the national average, but is probably in line with other similar installations along the Gulf Coast.

After the budget is prepared and approved, a semi-annual painting schedule is made up.

The paint and protective Coatings engineer works very closely with the Maintenance Planning group. The semi-annual paint schedule serves as the guide for maintenance planning.

Since cost and cost control are vital to any phase of maintenance, a system of keeping a record of each major painting job was initiated. This consists of a form made out to permit easy recording of the necessary data. The use of a standardized form also eliminates the possibility of overlooking a portion of the information necessary to the complete evaluation of the paint job. A description of the structure, vessel, etc., to be painted is recorded along with the necessary comments about the weather and other variables affecting the job. The entire job is checked with a magnetic-thickness indicating instrument and with a holiday detector. The mil thickness of each successive paint layer is checked and recorded. The use of these two tools has greatly increased the life of all paint jobs. The holiday detector indicates where pin holes, skipped or thin areas of paint exist and these areas are reinforced prior to the application of the last coat of paint. The labor and material cost of each job is recorded. A note describing the particular paint system is made, eliminating any guess work that might arise in the future in trying to identify the paint. Knowing all this information makes it a simple matter to get the true cost of protecting the subject structure or equipment.

Meet the Author

LEW T. GRAY is technical assistant to the services superintendent at Phillips Chemical Co., Adams Terminal, Pasadena, Texas. Gray received a B.S. degree in economics from the University of Arizona. His professional experience consists of instrument, construction, process and maintenance engineering with Phillips Chemical. This experience was gained since 1952 in sulfur, ammonia, ammonium sulfate, triple superphosphate and pyridine.

Economics of Painting—Once a painting program is started there will be many questions concerning cost of economics of painting that will arise. Today there are many new paints on the market, with other paints in late development stages. Alkyd, phenolic, vinyl, epoxy, neoprene based, rubber based and many others, along with modifications of these paints, present themselves for plant maintenance use. Even with such a variety of paints, it many times proves to be more economical to galvanize, or to use some less expensive paint such as a linseed oil based paint. One of Phillips' most chronic corrosion problems was best met by the use of a linseed oil-asbestos fiber filled paint. This paint applied at a 20 mil thickness over a hot sprayed, modified phenolic primer solved a corrosion problem in the ammonia sulfate plant that caused premature failure on dozens of other more expensive (cost per gallon) paints.

Another economic problem that will invariably arise is whether or not the sand blasting grit should be reclaimed, or whether a specially prepared graded and dried sand should be used, or an ungraded sand. This question can be answered only by comparing the cost of equipment and labor necessary to do the reclaiming work with the cost of new sand. It has been Phillips' experience that it is more economical to purchase new sand than to attempt reclaiming.

A field that has been investigated is the incorporation of corrosion prevention into basic design. This is particularly true in regard to steel structures. Pipe substituted for I-beams and angle iron eliminates many sharp corners and edges. Full smooth seam welds have been substituted for rivets and bolts. Back to back angle iron, rivets, bolts, etc., have always been a source of trouble in all plants. The use of pipe in structures has paid big dividends in certain troublesome cases.[1]

The plant painting crew is exposed to a number of occupational hazards. Therefore, the plant safety program should very definitely be organized to care for the paint crew needs. Here the painter foreman should work very closely with the Safety Department in order that the best respirators, goggles, gloves, ladders, etc., are provided. It will be necessary to instruct the painters in personal hygiene habits they must observe since many paints have mildew inhibiting chemicals that are toxic. The fumes from most paints are toxic if inhaled in too large a quantity. Instruction on the use of safety belts, fresh air masks, and guard rails on scaffolding should be a part of the every day routine in a paint shop. Of utmost importance is the habit of keeping a clean shop. Paint and solvent soaked rags must be properly disposed of. Smoking rules must be set and firmly enforced.

There is a real challenge to setting up a paint program in modern chemical and petroleum processing industries. The selection of the proper individuals to lead in corrosion control will assure that the most benefit will be derived from each paint dollar.

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Maintenance Must Be Planned

Here is a nine-point guide to proper maintenance planning. Any plant can use this basic skeleton outline to plan its program.

Ernest W. Fair
Boulder, Colo.

1. Responsibility—Determining just who will be responsible for application of the program after it has been drawn up is essential. Without fixed and definite responsibility on one individual in the organization the program itself will falter no matter how good the plan.

In turn there must be a definite degree of responsibility assigned to every person on the plant staff who uses any equipment therein. They should each know and understand the maintenance plan and particularly their own part in carrying it out.

2. Financial support of the plan is vital. The program should always take care of this phase of maintenance. And the sums allotted it should be flexible enough to take care of unusual conditions and circumstances.

Approval of management may well be required, under the program, where estimated cost of labor and materials exceeds a certain amount (usually about $25) and thus a degree of control retained over the costs of the program. Minor expenditures can best be left to people in the plant concerned with maintenance in order to avoid useless (and endless) record keeping chores on the part of the plant official in charge of the maintenance program.

3. Maintenance records are vital to any good program. They should be set up at the very start and maintained as religiously as are the records on receipts and expenditures in the front office. The best procedure is to set up an individual card record for each piece of major equipment in the plant. This card should detail the maintenance history of that piece of equipment. Usually such records are maintained in the office of the individual placed in charge of the maintenance program.

4. Work schedules for periods directly ahead should be part of the program. These should be made up on three classes of work: (1) jobs which can be definitely planned well ahead, such as inspections and routine jobs. (2) jobs which may vary with conditions but nevertheless must be fitted in at approximate times, and (3) jobs which must be done as emergencies arise. Flexibility in the master schedule is needed to handle the latter type of maintenance jobs.

5. A daily work program is the next step in the schedule. This should be made out from the outline of work ahead and fitting in emergency jobs for which orders or requests have just been received at that particular time. Without such records maintenance easily becomes haphazard. With records of this type even the minutest maintenance procedure acquires fixed standing and responsibility and is certain to be handled properly at the right time.

6. Maintenance materials requirements should also be calculated when the program has been set up. When this procedure is followed control of cost of maintenance is much closer. This also assures those concerned that funds will be available for such maintenance work as it arises and that nothing need ever be "put off" because of the lack of funds at any particular time. This latter procedure is one of the major sins of maintenance in many plants today. Each time needed maintenance is postponed for any reason whatsoever the future life of that particular piece of equipment is shortened by every day that goes by without the proper maintenance work being done.

7. Service data—Obtaining the proper information and data for correct maintenance is also an important part of any such program. A file of service and maintenance data as supplied originally by the manufacturer of each piece of equipment should be set up. Where these have been lost replacements should be secured immediately. This helps keep out mistakes in maintenance which can sometimes be as costly as complete absence of that maintenance.

Such a file should also contain lubrication charts and other maintenance data from every possible source. Information carried in the pages of this magazine from month to month should be kept available for not only routine maintenance procedures but as a source of data when something unexpected arises and there is no available experience on the plant staff to handle that situation.

8. Training—Any good maintenance program also allows for periodic training and instruction not only of the individual or individuals in charge of maintenance in the plant but of every man and woman who uses any machine therein.

The over-all job of good and low-cost maintenance is always much easier accomplished in any refinery where everyone on the staff is maintenance conscious and kept that way through a periodic maintenance demonstration or discussion.

9. Time charts should be established for each machine in the refinery. These should assure the plant management that each unit receives proper maintenance attention as frequently as needed. Such charts also have a big advantage in permitting scheduling of each individual maintenance job with each other so that there are no periods of heavy maintenance load and others with relatively nothing to do. ##

Does Inspection Increase Maintenance Costs?

This is an old argument but the real question is, can inspection be managed so that it will never increase maintenance costs?

J. O. Thoen
Continental Oil Company
Ponca City, Okla.

WHEN SOMEONE makes the observation that it appears that inspection causes high maintenance costs, it is not easy to return a pat answer in refutation. The fact is that it can be true. Is it always the case, however; and, if not true, can inspection be so managed that it will never increase maintenance costs?

The reasons for the belief that inspection does raise costs are logical enough. Those who know inspection, particularly of refinery processing units, have observed two things especially. In the first place, it is found that many, if not most, of the things inspected do not need repairs; therefore the cost of the work involved which includes preparation for inspection, such as blinding, purging, disassembling, the inspection itself, and reassembling would appear to be wasted. Secondly, it frequently happens that more repair work is done than is needed. Many types of equipment can be in imperfect condition but could be operated safely and efficiently for a long time without being repaired. A simple example is that of a valve which may leak slightly—but the leak is of no significance either in the operation or in the shutdown.

The other viewpoint is that inspection is a preventive maintenance measure, and as such it should reduce costs. Equipment is repaired in time to prevent major failures. Such breakdowns not only can be very costly in themselves but can cause damage to adjacent equipment. They may cause extended shutdowns, which means loss of production. Comparatively, the cost of maintenance is almost negligible.

Look at the different types of costs connected with inspection. The Inspection department in Continental Oil Company's Manufacturing department consists of nine men, a supervisor, and a part-time clerk. The yearly cost of maintaining this organization, including salaries, office expense, traveling, etc., is $122,500. There is considerable travel, since the group is located in Ponca City (with the exception of one resident inspector in one of the other larger plants) and generally travels by automobile to the other six refineries, about 15 gasoline plants, and 4 petrochemical plants.

This cost is not charged directly to maintenance but to administrative overhead. There are other items of expense which are charged directly to maintenance. These are repairs to inspection instruments and tools worth approximately $25,000, the maintenance of which is not a large item, and, more important, the mechanical work necessary to facilitate inspection during the shutdown. This work consists of such things as scaffolding, removing and replacing insulation, unheading and dismantling equipment, and sometimes doing special cleaning or grinding work to prepare the surfaces for inspection. This cost in 1955 was $52,000.

Another expense not chargeable to maintenance is the safety work. This consists largely of blinding, purging, and safety testing. The safety men do other work not connected with inspection, and no separate record is kept. It is estimated that their work and the mechanical work required by our safety standards in connection with inspections are not less than $100,000 per year in the seven refineries in the Manufacturing department.

Regardless of how these costs are classified in the accounting records, they do represent true expense of the inspection program. Summing them up, they come to approximately $275,000 a year. This represents about 8 percent of the total maintenance expense of the department.

There are, therefore, three ways in which inspection may cause unnecessarily high costs, whether called maintenance or not. First, more safety work than necessary may be done; secondly, more actual inspection work may be done than is needed; and thirdly, much more maintenance work may be done than is necessary even from a preventive maintenance standpoint.

How can these excessive costs be reduced? In principle the answer is simple. What is needed in each case is standardization and control.

In application and administration, the problem is not so simple. First, maintenance standards must be set up. As mentioned above, many types of equipment do not need to be in absolutely perfect condition in order to be operated safely and efficiently. Long experience with a vigorously pursued preventive maintenance system will provide the information necessary to judge the necessary frequency and extent of repairs. Practical, adequate standards can be estab-

lished without compromising safety. The two opposing views—one that it is best to take no chance but to inspect and repair everything if there is any possibility of imperfection and the other that no maintenance be done until it is obvious that it is absolutely necessary—must be reconciled. This should be done scientifically by an impartial and realistic study of the facts.

It may be objected that whether or not we have maintenance standards is immaterial, since we are concerned only with the effect of inspection on maintenance, be the standard high or low. This argument, however, misses a point, since, without standards which specifically state what shall be done under every condition revealed by inspection, we cannot be sure that some jobs are not overdone any more than we can know that others are neglected.

Standards cannot, of course, be very effective without well organized supervision. Someone must be at hand to see that they are followed. Another burden on supervision is the job of handling the cases which are not covered by standards. No system of standards, however well pursued, can expect a coverage of more than about 80 percent of all the work. The other 20 percent must be handled by on-the-job analysis on the part of expert supervisors who are familiar with the development of standards.

People who are not trained along this line should not be allowed to make the decision. For example, a cast-iron tray in a fractionating tower may be found to have a crack in it. An ardent maintenance man or operating foreman may decide immediately that it must be replaced. If the bubble caps are hard to remove or show slight traces of corrosion, there may be a quick and arbitrary decision to scrap them along with the tray.

Careful analysis of the situation by competent people would possibly reveal that the crack is of no significance from the operating efficiency standpoint. Analysis of the records may show that there has been no loss of fractionating efficiency, metallurgical examination may indicate that there is little likelihood that the crack will enlarge, and engineering analysis will show that there is no danger of structural failure; therefore the life expectancy of the tray may be as good as any of the others which are not damaged.

As far as we know, few companies have complete manuals of maintenance standards and procedures. Continental Oil Company is no exception. Except for those included in the nationally recognized power, pressure vessel, and piping codes, relatively few are written in specific terms; however our design standards are applicable in many cases to maintenance. For the rest, there are the unwritten standard practices and procedures developed by skilled and experienced mechanics. This is particularly true of repetitive work.

The Inspection department proper handles only the more critical equipment subject to high temperatures and pressures and to corrosion. Other equipment is inspected by mechanics.

Does the Inspection department inspect too much? We do not think so. In the many cases where no repair work is required, the information obtained by inspection is necessary in order to predict the life of equipment and to afford means of anticipating the time when repairs are needed. This allows time for efficient planning and preparation of the work.

After a few turn-arounds, the inspectors know which parts of a unit —such as tower, drums, exchangers, and piping systems—need careful checking at each inspection and which parts may be omitted from the schedule, sometimes for years.

Does the Inspection department require too much maintenance? Again, no. In the first place, they cannot demand anything. They merely call attention to defective conditions and state what must be done to bring the equipment up to the standards demanded by the code. Faulty mechanical conditions which do not affect the structural safety of equipment are reported but without recommendations. The cracked bubble tray referred to above is a case in point.

The inspectors are responsible only for determining what the established codes and related company standards require to be done. They are not responsible for safety or maintenance cost. A policy which would place such responsibility upon an Inspection department would result in a tendency toward overinspection and high maintenance cost.

In the case of the other equipment, the situation is somewhat different. Unless the work is covered by good inspection and maintenance standards, it is possible for a lot of unnecessary work to be done.

With a good accounting system, high costs of any type of equipment can be spotted. It can be compared with past performance and with similar items on other units. It then becomes a subject for investigation and development of corrective measures, which are generally not too difficult.

What has been said of the Maintenance and the Inspection organizations also goes for the Safety department. Safety measures can be run to excess—and they often are. Again it is the matter of a reasonable policy covering procedures which experience has shown to be adequate.

Excessive costs because of inspection probably exist in some degree in every company which has adopted a fixed policy of routine inspection. These costs cannot be accurately determined. If they could be determined and were found to be quite high, what steps could be taken other than to try to reduce them? This would not be done by abandoning the principle of inspection or limiting its scope but by the means described above.

There is no substitute for safety, and there can be no fair price for human life. Before the inspection routine was officially organized over 25 years ago, there were several (not many but more than one) fatal accidents which could have been prevented by the inspection practices now in effect in Continental Oil Company. Since standardized inspection was put into effect, there has not been one such fatality in any plant in which the Inspection department has operated.

It would be even more difficult to determine the maintenance savings resulting from the preventive effects of inspection.

In our company we do not think anyone has any doubt that these savings far offset all of the costs referred to above. Before inspection was organized, it was not unusual to have three or four serious fires per year in the Ponca City plant. Now it takes 15 or 20 years for that many fires to occur. Credit must also be given here to other organizational improvements particularly to more highly skilled operators and better safety practices.

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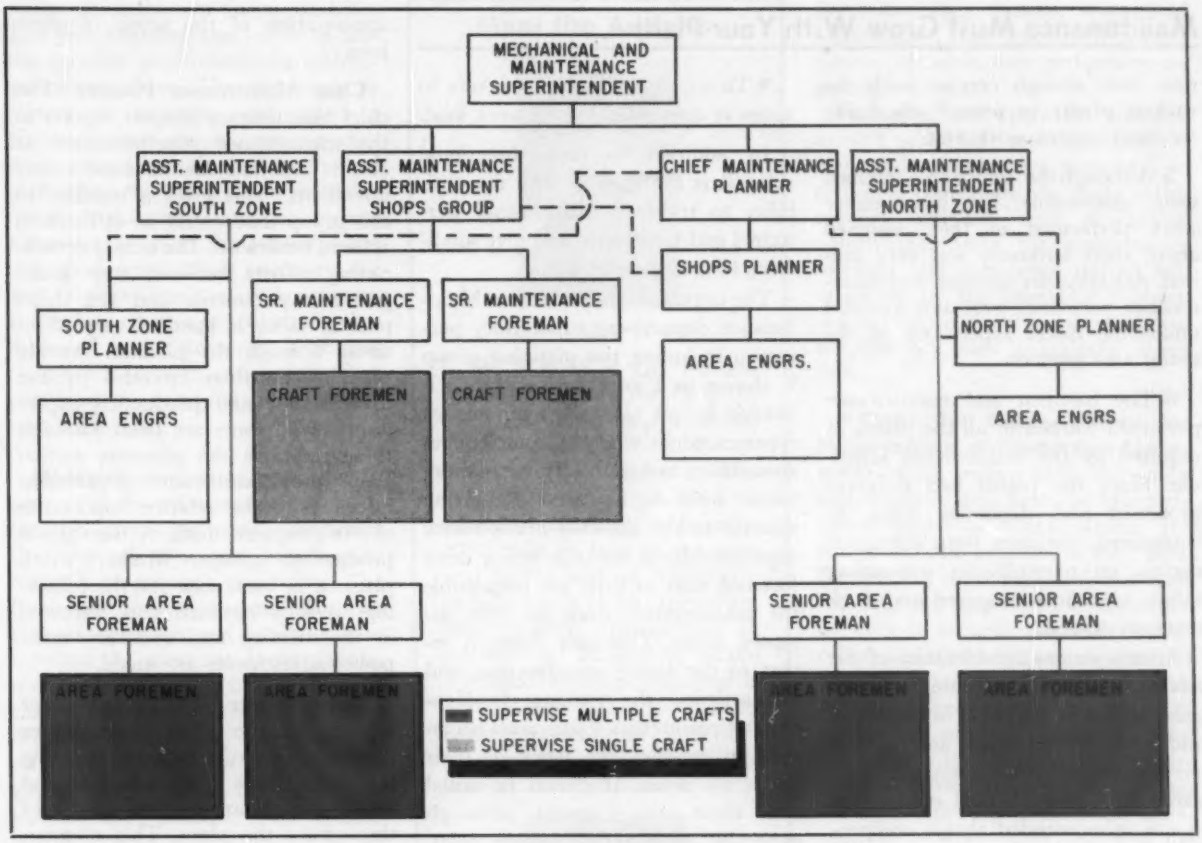


DECENTRALIZED MAINTENANCE ORGANIZATION

Maintenance Must Grow With Your Plant

Here's how one plant combined the good points of Zone and Centralized maintenance systems and reduced labor costs even though the plant continued to grow.

E. W. Jones and J. C. Shouse, Phillips Chemical Company, Pasadena, Texas

THE ADAMS TERMINAL of the Phillips Chemical Company experienced an unusual rate of growth during the post war years. Plant maintenance manpower continued to increase during this growth, as the work load demanded. The centralized type maintenance organization that was originally set up became inadequate as described in the following study.

1. The centralized maintenance organization could not cope with the scope of problems brought on by expansion and diversification.

2. Considerable travel time developed because manpower assignments required their moving from one job to another over a wide area. This was caused by the geographic location of the various plants with respect to each other as well as to the various maintenance shops. Several factors including minimizing fire, flood, and explosion hazards, sub-soils for foundations and the actual area available for expansion influenced decisions to keep the plants separated geographically. These distances, as much as two miles in some instances, created considerable difficulties in efficient utilization of maintenance manpower under the centralized maintenance organization that existed. The problem was largely one of communications and of moving manpower to the job locations as required by the maintenance scheduling group. Actual plant acreage increased 2½ times.

3. The central tool room location was a serious bottleneck.

4. It was difficult, if not impossible, for the maintenance planner to main-

tain close enough contact with the various plants to permit scheduling the most urgent work first.

5. Although the senior area foremen were responsible for maintenance work performed in their assigned areas, their authority was very limited. Actually, the foremen and maintenance personnel were not assigned under the direct supervision of the senior area foremen.

6. The foremen and maintenance personnel worked in all the plants as required by the maintenance schedule. Since the plants had different processes and dissimilar types of equipment, the men were often uncertain on procedures concerning safety, cleanliness required and work methods desired.

After a serious consideration of the advantages and disadvantages of the existing maintenance organization and after several visits and surveys were made of other companies' organizations and physical equipment, it was recommended that a compromise between a centralized and a completely decentralized maintenance organization be adopted. The aim was to utilize the better points of both systems. The proposal, as accepted, basically divided the plant into two physical zones plus a shops group.

The Shops Group is comprised of shop maintenance personnel, general maintenance workmen and shift maintenance personnel. Their functions are:

- To maintain general utilities serving all plants, such as: roads, electric power, gas, water, and raw product lines.
- To operate skilled shops for major overhauls and fabrication of equipment.
- To dispatch, operate and maintain the mobile equipment.
- To paint and insulate.
- Carpentry and masonry work.
- To provide maintenance personnel and supervision for shift maintenance work.
- To supply additional workers to zones as demanded by the work load.

In addition to these functional roles, it is the shop group's responsibility to train all maintenance personnel and to prepare and give qualifying tests to these men.

The organization of the new Maintenance department supervisory personnel including the planning group is shown in Figure 1. Each zone is headed by an assistant maintenance superintendent who has complete responsibility and authority for maintenance work in his zone. Reporting directly to the assistant maintenance superintendents are the senior area foremen who in turn are responsible for maintenance work in their assigned areas. The area foremen report to the senior area foreman and are assigned the various classifications of maintenance personnel necessary to conduct the work in their respective areas. It should be noted that these area foremen, although generally assigned to certain units, are primarily job foremen in that they have complete responsibility for all work incidental to the final completion of all repair jobs in their assigned area.

Although the new maintenance organization has been operating for only six months, an over-all improvement in manpower efficiency is realized. Refinements are continually being made in (a) the maintenance planning program, (b) maintenance manpower and supervisory assignments, (c) work methods and procedures, and (d) material selection and delivery.

Planning and Scheduling—The Planning and Scheduling section is charged with the responsibility of coordinating requests for manpower and scheduling maintenance personnel to jobs in a manner that not only puts highest priority work first, but so that there is a smooth flow of material and men to and from the job with a minimum of lost time. A detailed account of each job in the planning group is necessary for full appreciation of the scope of these jobs.

Chief Maintenance Planner—The chief maintenance planner reports to the maintenance superintendent as do the assistant maintenance superintendents. This gives a stability to this group that would be difficult to achieve otherwise. The actual coordinating efforts between zone manpower requirements and the shops pool of labor is handled very effectively through the planner. Weekly planning meetings attended by the maintenance and production supervisors of all zones are held. Through these meetings the planning section keeps the Maintenance department informed of the relative importance of work requests made by the various production groups. Major work planned in each zone for the following week is outlined and discussed in the meeting and necessary manpower adjustments are made.

Shops Planner—The shops planner reports to the chief maintenance planner. His duties include preparing the daily shops work schedule and assisting in balancing the manpower throughout the plant. This planner, through a daily talk of from 5 to 10 minutes with each maintenance foreman, has a feel of the progress being made on all scheduled jobs. The schedule, for this reason, is always current and never lags behind or gets ahead of the actual work.

Zone Planner—The zone planner reports directly to the zone assistant maintenance superintendent. Thus a direct link between the work and the planning group is maintained. The zone planner reports indirectly to the chief maintenance planner thus assuring that the zone planner's efforts will be in accord with overall plant maintenance needs. The zone planners prepare a daily work schedule, approved by the Operating department, which includes the work to be done in each zone. These schedules are typed and distributed to personnel needing them. Copies of the work orders are furnished to the area foremen who in turn, make their work assignments.

Area Engineers—The area engineer reports directly to the zone planner. This is the planning group's direct

contact with the first line supervision. The area engineer also serves as liaison between production and maintenance supervision. The area engineer reviews all incoming work orders in his area from an economic standpoint, determines the best method of performing the work, orders material, estimates manpower and sets up the sequence in which the job steps are to be performed. When necessary, the area engineer initiates work requests, and at times makes expedient sketches in lieu of formal drawings. Technical counsel for foremen and maintenance personnel is provided through the area engineers.

Material Control—Since about 50 percent of the maintenance cost is for material, it is extremely important that the selection and handling of material be properly supervised. The Planning group's responsibility on material selection and handling is to see that the most satisfactory material for the job is purchased. Through close inspection and control the ratio of warehouse stock investment to total plant investment is kept at the lowest point consistent with good maintenance practice. All maintenance material is requisitioned either through or by the area engineer. This permits the planning section to exercise a very favorable type of control over warehouse stock items.

Maintenance work order material is identified by work order number. The Warehouse maintains delivery trucks which move material to predesignated spots throughout the plants. These deliveries can be accomplished in a few minutes if necessary. Routine maintenance items are kept on hand in the zone tool rooms and are available for immediate use.

To better illustrate the advantages gained through the use of the new maintenance organization, a summary of the improvements is listed:

• **Improved Working Arrangements Between Operations and Maintenance**—The maintenance zones were organized to correspond with the operating areas; the operation foremen and operators work together with the same maintenance foremen and maintenance personnel on a continuing basis in coordinating area activities. When operating and maintenance personnel work together every day they become acquainted with each other and each other's method of work, thus performing together as a team.

Formerly, the operation foremen worked with many maintenance foremen and maintenance personnel in trying to coordinate the daily maintenance activities with production schedules. Since the maintenance foremen and men were shifted into many areas, the operating foremen worked with a different group of maintenance men practically every day.

• **Clear Cut Responsibility for Maintenance of Production Equipment**—Each senior area foreman and assigned men have the complete responsibility of maintaining the equipment and property in their area. Under previous conditions, the craft foreman and men might be scheduled to work in an area one day and another area the next; consequently, a sense of responsibility for the maintenance of any particular group of equipment was not acquired. Now, since the maintenance personnel are assigned to definite areas, the responsibility for the supervision and maintenance is more exact and well defined.

• **Increased Familiarity with Equipment**—The continued repairing of the same equipment over a longer period of time has permitted the area maintenance personnel to become thoroughly familiar with this equipment. Improved methods and procedures of repair are learned. Short cuts developed through increased skill enables the personnel to do a faster and higher quality repair job.

Under the previous system a maintenance man and helper would repair a machine when it breaks down, but another maintenance man and helper would probably be scheduled to the repair job the next time the machine needed repairs.

• **Reduced Travel Time**—Since the maintenance and supervision personnel report to their respective assigned areas every morning, much travel time to and from the job is saved and utilized as working time. The other travel times, such as going for tools, materials, etc., have also been greatly reduced, thus releasing many more maintenance working

Meet the Authors

Jones

E. W. JONES is chief maintenance planner for Phillips Chemical Co., Adams Terminal Plant, Pasadena, Texas. He received his B.S. degree in electrical engineering from the University of Arkansas in January, 1950, then in June of the same year he received his B.S. degree in mechanical engineering. Shortly after graduation he started with Phillips at Adams Terminal. He spent one year in design, two years in maintenance engineering, and three years in planning with the last year as chief planner.

Shouse

J. C. SHOUSE is senior mechanical supervisor in charge of the main maintenance shop for Phillips Chemical Co., Pasadena, Texas. He joined Phillips in the refining department in 1948, and worked at the Okmulgee and Kansas City refineries. In 1953 he transferred to the Research and Development department, Rocket Fuels division, where he assisted in organizing the maintenance for the new rocket fuel plant, and served as chief maintenance planner. Then in 1955 he was transferred to Phillips Chemical Adams Terminal. Shouse graduated from Oklahoma A. & M. College with a B.S. degree in electrical engineering.

hours per year which are being utilized for a gainful purpose. This also results in minimum manpower requirements.

Under the previous system the maintenance personnel traveled to and from the areas as per maintenance schedules and as emergency work orders demanded.

• **Tools and Small Material Items More Readily Available**—Tool rooms are now located in each zone for the use of maintenance personnel within that zone. Tools that were built or purchased for particular zone jobs are located in that zone tool room. Small material parts are also stored in the tool rooms where necessary to reduce time required in obtaining such parts, enabling more expedient job handling. These parts are only those used frequently, such as: bolts, nuts, gaskets, nipples, fittings, etc. The additional tool room has materialized the following advantages:

- Fewer lost tools
- More accurate tool records
- Less confusion and lost time in issuing tools
- Reduced time lost traveling to obtain tools and small parts resulting in reduced time necessary to complete the repair job.

Previously there was time lost because the proper tools were not carried to the job site. Sometimes several trips were required to obtain all the tools necessary. Even when the tool delivery service was used, time was lost in waiting. The cost of stocking the additional tool room has been well balanced by craft labor time that is better utilized. In time this will more than pay for the cost of tools. Reduced time spent in obtaining tools has reduced down time on equipment.

• **Creates Personal Pride, Interest, and Incentive in Work**—Since the areas of maintenance responsibilities are well defined, the maintenance supervisors and maintenance personnel soon became so associated with the equipment that a sense of personal pride is acquired in keeping this equipment in good operating condition. The maintenance personnel are more likely to acquire a feeling of ownership for the equipment they must maintain. Letters of recommendation and praise, such as increased production records, are addressed to the area assigned maintenance personnel as well as to the operational personnel, thus not only increasing the pride in their work, but also the bond of working together for a common goal. People who are proud of the work that they are doing are happier, more interested, and have a greater incentive to do a better job.

• **Improved Communications**—With permanent areas of assignment for maintenance personnel and supervisors, the channels of communication for work direction, advice, and coordination of maintenance personnel is greatly improved. The improved communications are even more noticeable between maintenance and operations since operations is physically nearer to maintenance. Fewer maintenance supervisors have to be contacted in order to line out and complete a maintenance job.

Under previous conditions the maintenance personnel and supervisors scheduled in an operating area changed from day to day, not only in number, but also in crafts and different men within the same craft. Under such a changing situation it was difficult to maintian good communications between maintenance and operations, and sometimes within the maintenance group itself. Many meetings and conferences were held by the maintenance and operational supervisors for informational and discussional purposes of planned maintenance activities. The frequency of the meetings and especially the number of employes attending these meetings have been reduced considerably.

• **Positive Maintenance Supervision**—Since the maintenance personnel are permanently assigned to specific areas under the direct line supervision of a foreman, there is no doubt as to whom the maintenance man reports for supervision. This situation means to the workman what a home-classroom and home-teacher means to the high school student—a definite place to report for instruction and help. Thus, by reporting to the same supervisor and to the same area each morning, more positive maintenance supervision is achieved.

Under the previous system, the maintenance men did not know from day to day where they would work or to whom they would report. This presented problems as to how they should dress for work and where they should keep their lunches. Likewise, the senior area foremen had been delegated considerable responsibility with very little authority; their problems sometimes left them frustrated.

• **Clean End-Product**—Under the previous program, maintenance men were scheduled into the different areas as the work loads demanded; consequently, a maintenance man could have worked in several areas during any eight hour period. In some areas the repair job may have been located in a rather dirty location. If the dirt, grease, and any other foreign material that accumulates on the maintenance personnel's hands, clothing and tools become integrated into the product stream of a process, the purity of the process end-product may be reduced. In certain chemical processes impurities in process stream can discolor or contaminate the chemical make-up of the end-product so much that it would have to be recycled or discarded.

Under the present program, the maintenance personnel work in the same area each day results in eliminating impurities from outside areas being brought into their work areas. Also the maintenance man's greater familiarity with assigned equipment allows him to assist in assuring that impurities are kept out of the process stream.

• **Expansion**—This is a flexible type of organization which enables the maintenance forces to keep up with future plant expansion by the addition of more zone organizations. This type organization also permits over-all effective control of maintenance work for future plant expansion. Training foremen and maintenance personnel has so greatly improved that it will be much less difficult to staff the Maintenance department for future expansion. ##

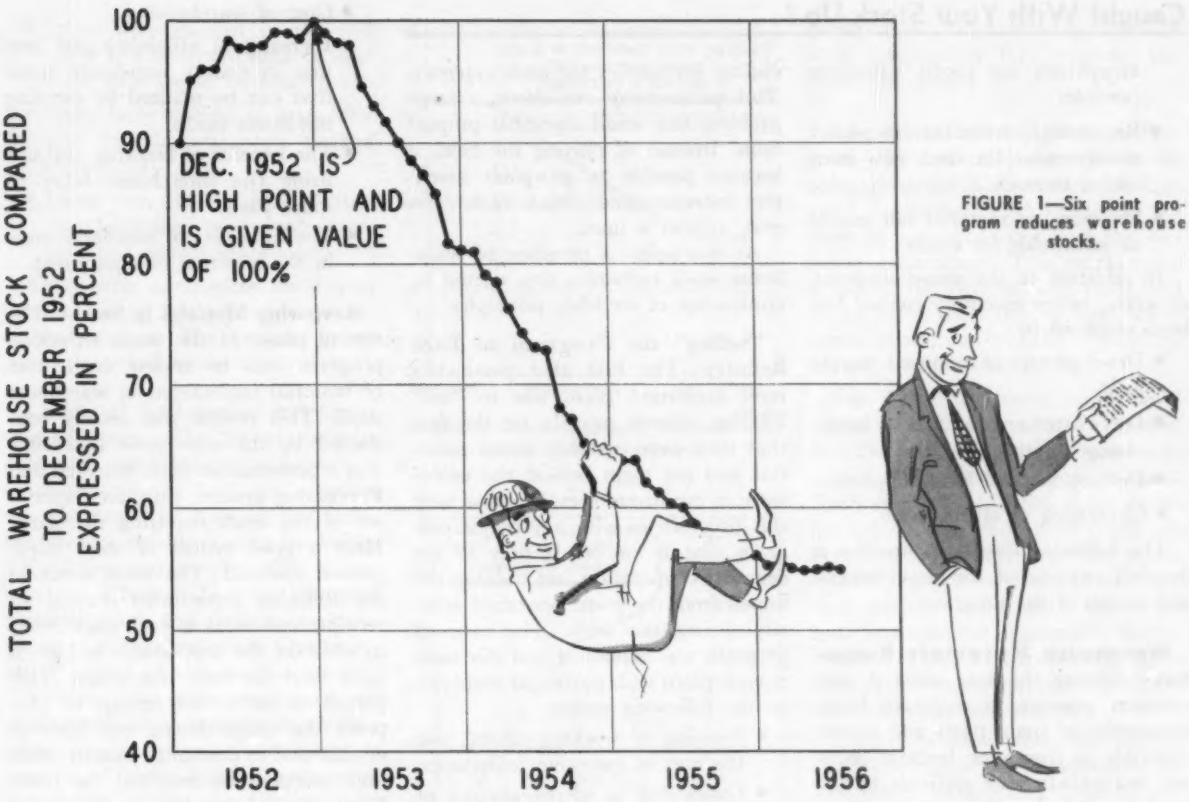


FIGURE 1—Six point program reduces warehouse stocks.

Are You Caught With Your Stock Up?

MAINTENANCE

Here's a way to reduce costs and increase profits through inventory control and warehouse stock reductions.

Joe W. Cook
Phillips Petroleum Company
Bartlesville, Oklahoma

IN THE REFINING industry where competition is very keen and the refiner's margin is very thin, inventory control and warehouse stock reductions offer one way of reducing costs and increasing profits. Inventory control is not new or unique, but only in recent years have refiners given emphasis to this method of cost reduction. Expansion and modernization programs have steadily increased the dollars tied up in maintenance material inventories and emphasized the need for improved control of maintenance materials.

A program of warehouse stock reduction and materials inventory control, started about five years ago by Phillips' Refining department, has reduced warehouse stocks some 45 percent below the December, 1952, level while refinery investment increased about 18 percent during the same period. Additional benefits have been higher stock activity with minimum obsolescence losses, increased efficiency in warehousing procedure, improved warehouse arrangements with more space for materials handling and movement, better interchangeability of parts, improved efficiency in ordering materials and better understanding of materials problems by craftsmen.

The materials control program has been developed with two main objectives: (1) warehouse stock reduction and (2) inventory control. Warehouse stock reduction is being accomplished by the following six-point program:

- "Selling" each refinery the fact that we are carrying excess material and getting them to cooperate in reducing inventories.
- Reviewing each item of material maintained in warehouse stock.
- Compiling a list of undesirable stock items or overstocked quantities.
- Returning surplus material to

suppliers for credit whenever possible.

- Requiring justification to plant management for each new item added to stock.
- Disposing of material not usable or returnable for credit.

In addition to the above six-point program, better inventory control has been obtained by:

- Development of material standards.
- Development of parts interchangeability.
- Development of local suppliers.
- Cataloging of all materials.

The following discussion presents a detailed review of the development and results of the program.

Warehouse Materials Reduction—During the war years it was common practice to maintain large inventories of spare parts and repair materials as insurance because parts and materials were difficult to get when needed. It was important that repair materials be on hand to keep the plants operating at their maximum capacity. As a result, inventories were maintained on the precept of being prepared for any eventuality instead of preparing for current probabilities.

Since the war refineries have expanded and modernized with new types of processing facilities. New and entirely different types of repair materials are needed to support plant operations. This further complicates the control of warehouse inventories.

Some four or five years ago when it became obvious that something had to be done to retard the steady increase in dollars tied up in maintenance material inventories, a study was started to establish definite controls on warehouse stocks of maintenance materials, repair materials and operating supplies.

Preliminary studies indicated that to effectively control inventories it was desirable to group the items into categories of similar materials. To accomplish this some changes in established accounting procedures were necessary. Inventories were grouped into categories and quarterly reports prepared showing the beginning inventory, material receipts, material issued and ending inventories for each category. This procedure cut down a large problem into small digestible proportions. Instead of playing the field, it became possible to pin-point inventory increases and attack each category, one at a time.

At this point a program of warehouse stock reduction was started by application of six basic principles.

"Selling" the Program to Each Refinery—The first and probably most important point was to "sell" Phillips refinery people on the fact that they were carrying excess material and get them behind the movement to cut inventories. It is true with this program as with any major program that it succeeds only to the degree of cooperation and backing obtained from the plant personnel actually doing the work. The over-all program was explained and discussed at each plant with particular emphasis on the following points:

- Freezing of working capital and the cost of excessive inventories.
- Losses due to obsolescence of stocks.
- Losses due to deterioration of stocks.
- How inventories are considered in the taxing of company assets.
- Cost of procurement of materials.
- Cost of warehousing.
- Increases in efficiency and savings in costly warehouse space that can be realized by carrying minimum stocks.
- The benefits of knowing and utilizing the interchangeability of spare parts.
- The benefits of standardization in the selection of equipment.

Meet the Author

JOE W. COOK has been with Phillips Petroleum Co. since 1941 and now is in charge of the material procurement section for the refining department in Bartlesville, Okla. He has a broad background in material control, warehousing and purchasing, having served in two refineries and in the new construction section of the refining department prior to his present assignment.

Reviewing Material in Stock—The second phase of the stock reduction program was to review each item of material maintained in warehouse stock. This review was usually conducted by the warehouse supervisor and representatives from Material and Purchasing groups, with the supervisor of the craft requiring the parts. Here a good system of stock cards proved essential. The stock cards in the Refining department showed all receipts and issues of each stock item; in addition, the unit charge was given each time the item was issued. This permitted the review group to pinpoint the usage during any interval of time and to determine exactly what unit or operation required the item. From this information an accurate stock level could be determined. From the usage figure and the maximum quantity desired, it was possible to calculate an order point and an order quantity. The minimum stock level as insurance against costly unit downtime was re-evaluated on each critical item. These points took into consideration the cost of procurement, cost of warehousing, provided estimates for availability of materials, and provided for consideration of insurance minimum quantities.

This item-by-item review of some 50,000 items was slow and time consuming. However, the results of this investigation were very rewarding and are set out below. It was determined that in some instances:

- Items were stocked that were not necessary for normal maintenance.
- Duplicated items were in stock having different stock descriptions.
- Items were stocked in the same physical size, but in several different alloys (sometimes not nessessary).
- Items were obsolete.
- Items were stocked for equipment no longer in service.

- Items were stocked in the full range of sizes where three or four basic sizes would be satisfactory.
- Items were stocked in assemblies and the identical parts stocked individually.
- Items were stocked in quantities that according to current usage, provided several years supply.

There were a sufficient number of these cases to warrant continuation of the program. The largest group was overstocked quantities.

Listing of Undesirable and Overstocked Items—The list of undesirable and overstocked items gave a description of the item, the supplier, the quantity, the date of last issue, the present condition, and the value. This listing was simply called a surplus list. These lists were compiled plant by plant, and arranged by categories of similar materials. One interesting aspect of this surplus list was that items that were surplus in one plant would be in demand in another plant in the company. As many as possible of these surplus items were transferred within the company so that the dormant material was put to work.

To be effective, the surplus lists were delivered to a group in the central Purchasing department. All requisitions for materials were routed through this group and were filled from surplus materials as far as possible. This procedure placed control in a central point and made possible the transfer of material to phases of operations other than refining. New lists were prepared periodically in order to provide accurate and up-to-date information. Also, the preparation of new surplus lists was definite assurance that inventories were being analyzed periodically.

Credit for Surplus Materials—Asking suppliers to take back for credit surplus new material was only partially successful. In most instances we expect the supplier to discount material returned for credit as a restocking and handling charge. A "bird-in-the-hand" attitude was adopted in trying to recover some of the purchase price of surplus materials.

Justification of New Items—An important phase of the inventory reduction and control program is to require that each new item added to stock be justified to plant management. This is an important function and should be carefully watched. Once an item becomes "stocked" it may become a regularly carired item and is more difficult to eliminate than if it had never been purchased. A rule of thumb policy is to eliminate an old item before adding a new one. This, of course, cannot be adhered to at all times but certainly gives us something to shoot for.

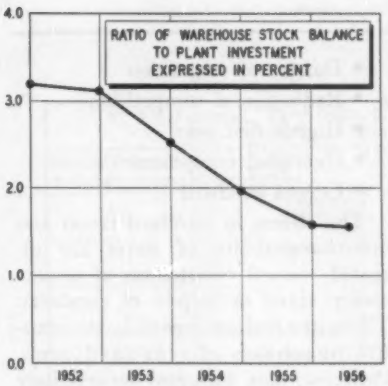


FIGURE 2—Plant investment increases while warehouse stocks decrease.

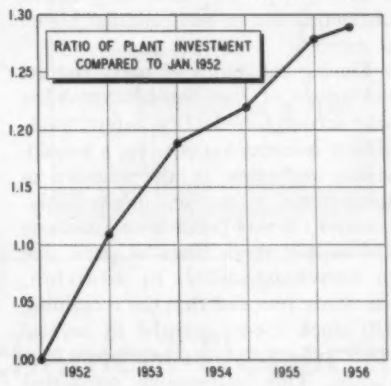


FIGURE 3—This program reduces ratio of warehouse stocks to total investment.

Difficult Disposal Problems—Certain quantities of materials cannot be utilized and cannot be returned for credit to suppliers. There are three possibilities for disposal of these items: (1) offer the materials for sale on a bid basis, (2) review the material to see if sacrifice is really desirable; if not, make plans for utilization, and (3) sell the remaining material for the junk or salvage value. The last alternative is always viewed with remorse by some personnel; however, by the time every possibility has been explored without success, there is little justification for keeping the items any longer.

Results of Stock Reduction Program—The effectiveness of this six point program is illustrated in Figure 1. December, 1952, represents the peak in warehouse stocks of the Refining department. This stock value is called 100 percent and using this as an index the value of total warehouse stock materials is plotted against time in months.

One interesting point of Figure 1 occurs during the months—November, December and January for successive years beginning with 1953. Goals of stock reduction were calculated for each refinery to reach the first of each calendar year. The plants continually reviewed stocks and utilized surplus items until the year's goal was reached, (generally in November). The reduction program then rested upon its laurels until the new year was well started.

Figure 1 shows that the present stock levels now are 55 percent of the December, 1952, index. This 45 percent stock reduction in three and one-half years is even more meaningful considering the continual growth of the Refining department. As new products were manufactured and new units built, it was necessary to stock many new items of spare parts.

Figure 2 shows the continued growth of the Refining department as represented by increase in plant investment. January, 1952, investment is taken as the index and is given the value 1. Changes in investment are shown as a ratio change from the January, 1952, value. Figure 2 shows an over-all increase of approximately 18 percent in investment during the same three and one-half years that warehouse inventories decreased 45 percent. The normal expectation is that warehouse stock inventories should change proportionally to Plant Investment. Note that in 1952, warehouse stock increased in proportion to increase in plant investment. With the program in effect, the continued efforts of stock reduction more than offset the value of new stock items attributable to new manufacturing units.

Figure 3 is a graph of the ratio of total warehouse stocks to total investment during the interval January, 1952, through July, 1956. This shows

a continual decline to the present 1.58 percent. This ratio represents fifteen dollars and eighty cents worth of warehouse stocks for each one thousand dollars of plant investment.

How much this ratio can be reduced for economical operations has not been determined. It is anticipated that this ratio can be reduced further and still maintain a stock level that is satisfactory for plant maintenance. Percentage of investment is only an index to measure accomplishments and can be misleading because of the age of equipment versus replacement costs and methods of depreciation. Other methods of setting inventories are being developed.

Since studies indicate that it costs a minimum of twenty cents per year to maintain each one dollar of stock in warehouse inventory, this program of warehouse stock reduction is being continued.

Inventory Control Projects—Now that the over-all picture of the warehouse reduction program has been reviewed, it is desirable to present some of the side projects that not only have a direct bearing on reduction of stocks, but are also effective for inventory control.

Standardization and Interchangeability—Standardization projects have been accelerated in Refining during the last several years. The projects have generally been in the field of mechanical equipment, although some work has been in progress in the electrical and instrumentation fields. Standardization, so far as warehousing and purchasing are concerned, resulted in many real benefits and a few handicaps. On the plus side of the ledger for standardization are benefits such as:

- Smaller repair parts inventory
- Simplified inventory records
- Simplified purchasing
- Smaller warehousing area required
- Better housekeeping
- Maintenance simplification
- Reduced tooling requirements
- Quicker training of maintenance personnel

Some of the disadvantages of standardization are:

- Danger of stagnation
- Reduction of competition
- Higher first cost
- Oversized equipment
- Loss of goodwill

The efforts in standardization and interchangeability of items are directed toward elimination of unnecessary sizes or types of products. There are real savings in large quantity purchases of standard items. However, this program is definitely not for "brand" standardization, because this results in stifled competition, complacency on the part of successful suppliers, lack of progress, outmoded design and eventual higher costs.

During cataloging of parts, the development of part interchangeability was accomplished. This interchangeability information permits a considerable reduction in the number of stock items. In a given pump manufacturer, it was possible to eliminate 110 of 430 stock items of parts due to interchangeability. In addition, this study revealed that the remaining 320 stock items would fit several other pumps, a fact heretofore unknown. This information permitted an increase of over 28 percent in the possible utility of the remaining stock items. These parts studies have been worthwhile even though a large amount of time is required to complete them.

Refinery warehouses have been successful in eliminating half of the stocked items in bolts and studs by stocking these items by one-half inch increments of length instead of one-quarter inch. Also a considerable reduction has been made in stocks of heat exchanger tubes, pipe and pipe fittings, valves, conduit and conduit fittings, and mechanical equipment parts with the elimination of duplicated items, determining satisfactory substitutes, and elimination of seldom used sizes.

Local Suppliers—Local suppliers and industrial supply houses in the immediate area of each refinery have been encouraged to maintain stocks in certain classes of standard items. These suppliers normally maintain some quantity of these items and with a slight increase in their quantities can supply on no prior notice the refinery's requirements. This permits the refinery to carry a very small stock of this type goods with replenishment from local suppliers periodically. The local supplier usually extends to the company competitive prices so that there is no advantage in the refinery purchasing and maintaining large quantities of this type goods. Among the items being handled in this manner are hand tools, lumber, some types of heat exchanger tubes, builders hardware, some types of valves, pipe and fittings. The development of suitable local suppliers results in four distinct advantages: (1) minimum stocks, (2) prompt replenishment with no delay of factory shipments, (3) increased sales of company product in the immediate refinery area, and (4) increased good will to the company in each refinery area.

Cataloging Program—A cataloging program was also started. The purpose of material catalogs is to enable the craftsman in the field to determine exactly the materials needed and to order from the warehouse the correct parts for the specific equipment being repaired. This is accomplished by giving in the catalog a parts listing that describes each part and provides the best possible illustration of the part, as a facing sheet, for the page listing the component parts. The cataloging is proceeding through the entire warehouse stocks by categories of materials.

Material Ordering Efficiency—One sidelight in the problem of operating a refinery with minimum economical warehouse stocks is the necessity for accurary in records. In times past, if a stock record on a given part gave the present quantity as six and actually there were four in the bin, there was little need for worry. Merely adjust the record balance and order some more. However, now the same article might have a normal stock of four with a reorder point at two. It is necessary that the stock balance agree with the records because of the serious danger of running out of stock. Improvements have been made in office procedure, issuing and receiving materials, and auditing so that stock records are currently 96 percent in agreement with the physical inventory of all materials. It is felt that the cost would be prohibitive to attain a higher degree of accuracy. ##

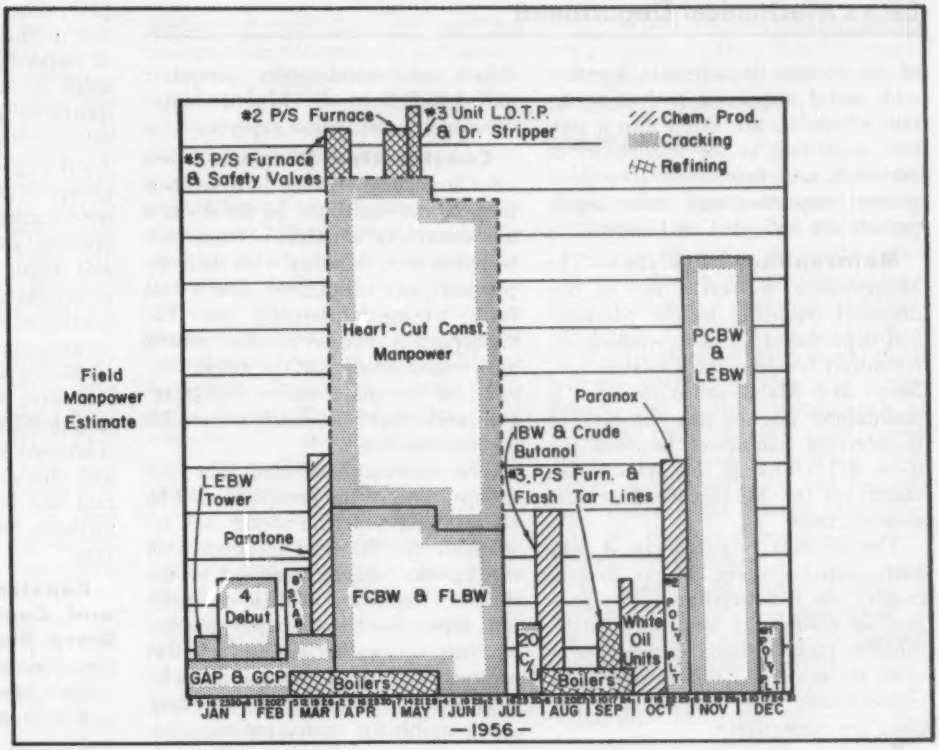


FIGURE 1—Inspection schedule: This is how Esso handles peak periods.

How Esso's Mechanical Department Works

This method provides a smooth transition from the Craft to the Field Supervision system.

THE MECHANICAL Department at Esso's Bayway Refinery was reorganized to conform with the concepts of a field supervision system. It was formerly organized under the Craft system which modern concepts of organization and planning have decreed as obsolete. The three major functions of the new system are as follows:

- **Planning**—The preparation for field work after engineering is completed including the establishment of operation sequence, the determination of craft skills required and the allocation of men for the duration needed to complete a job on schedule.
- **Job Execution**—Performed by field supervisors who are responsible for the performance of the men and who "coordinate" the delivery and the installation of equipment by craftsmen according to a predetermined schedule.
- **Personnel Administration and Craft Skill Development**—A service function concerned with the skill and effectiveness of Craftsmen. This function covers the responsibility to maintain personnel records, to improve the individual's skill through training and to recognize the personal needs, abilities, character, physical handicaps, need for discipline, etc.

Mechanical Planning—The planning section of the Mechanical department is a staff organization and is responsible for long-range scheduling and planning of all maintenance and construction work in the refinery. This involves scheduling the major work load of the mechanical forces, including large maintenance jobs, metal inspections and new construction. Operational requirements

of the Process departments, together with metal inspection and construction schedules, are fitted into a pattern according to the availability of materials and manpower. The peak general inspection and major repair periods are indicated on Figure 1.

Maintenance Division—The Maintenance division is one of five divisions reporting to the Mechanical department. A close working relationship between the Construction, Shops and Maintenance divisions is maintained due to the necessity of transferring manpower between the three divisions as the over-all demands on the Mechanical department dictates.

The division is subdivided into four control centers. These control centers are established along geographic boundaries and were established to include similar process operating divisions and similar operating responsibility. The maintenance regions are respectively:

Region 1—Atmospheric distillation operations, refining operations, steam, power, and other utilities.

Region 2—Thermal and Catalytic Cracking, Catalytic Conversion processes, (fuel products), and High Pressure Light Ends operations.

Region 3—Chemical Products operation.

Region 4—Oil Movement and Storage operations.

To insure further efficiency and singleness of purpose between Mechanical and Process people, the geographic demarcation of mechanical responsibility by regions was further subdivided into zones and areas to conform as nearly as practicable with the process fields of responsibility and supervision. This parallel organization in the same fields of responsibility improves communication between the first line process supervisor and the first line field supervisor for the performance of routine or emergency maintenance work.

Unusually large work requests are discussed by the field supervisor or the process unit supervisor with the corresponding maintenance zone supervisor who investigates to determine whether the daily manpower plan should be altered. Large jobs that cannot be handled on a routine basis are requested by the process division head according to an established mechanical order procedure and handled in the Maintenance division by the region supervisor.

Construction Division—When very large maintenance jobs are performed, the craftsmen in the division are essentially withdrawn from construction and, together with their supervisors, are transferred, like a task force, to the turnaround site. The Construction division assumes control and responsibility for the project instead of the maintenance region organization that is normally responsible for maintenance.

The division is divided into four groups. Two of the groups headed by construction superintendents are responsible for the field installation of the various projects assigned to the division. Reporting to these construction superintendents are job superintendents responsible for individual projects. The third group headed by a contract construction superintendent is responsible for contracted construction and contracted maintenance work within the plant. The number of engineers assigned to this group depends upon the magnitude and complexity of the contract work in the refinery. Coordinative and liaison contacts are made between the contractor and interested refinery, process, engineering or administrative personnel to resolve problems pertaining to schedules, field interference, and specification or standard interpretation. This group is responsible to see that the field work meets the contracted specifications, that the work is in accordance with engineering or refinery standards and the refinery safety rules and practices are followed.

The fourth group is headed by a Construction Engineering group head who is responsible for the detailed plans and schedules necessary for the construction superintendents to work the various projects and necessary for the development of short and long range manpower requirements within the division. Coordinative and liaison responsibilities are assigned to the various engineers reporting to the group head.

WHAT FIELD PEOPLE DO

Region Supervisors—The region supervisors maintain administrative control over the region planners, region schedulers, zone and job supervisors and field supervisors who plan, coordinate, schedule and direct the mechanical work in their areas of responsibility, ascertaining that all work is efficiently performed as required by process operations and the refinery's capital projects program. Each region supervisor keeps his group advised of administrative improvements, communicates company policies, improves work procedures, and assists his supervisors with their personnel problems. Other duties are participation in weekly meetings with process and engineering staff groups to discuss and establish job priorities, and solve maintenance and construction problems. They ascertain that all scheduled work is properly approved and charged to correct accounts, obtain and review cost data and direct methods for control and cost reduction.

Construction Superintendents and Construction Engineering Group Head—The construction superintendents maintain administrative control over the job superintendents and field supervisors who coordinate and direct the mechanical work in their areas of responsibility, ascertaining that all work is efficiently performed as required by process operations and the refinery's capital projects program. Each construction superintendent keeps his group advised of administrative improvements; communicates company policies; improves work procedures, and assists his supervisors with their personnel problems. Other duties are participating in meetings with process and engineering staff groups to discuss and establish job priorities and solve maintenance and construction problems. They ascertain that all scheduled work is properly approved and charged to correct accounts, obtain and review cost data and direct methods for control and cost reduction.

The Construction Engineering group head maintains administrative control over the construction engineers and region schedulers who coordinate and schedule the work for job superintendents. He maintains a close working relationship with the construction superintendents and assigns engineers for the execution of jobs working with the construction superintendent.

Region Planner (Maintenance and Construction Engineers)—These engineers handle detailed job planning for larger mechanical jobs, construc-

tion projects and process unit turnarounds and inspections. Each planner develops the sequence of operations and work methods, determines the number of men and equipment required, establishes whether materials are available, arranges for shop work when necessary, arranges for process equipment shutdown, investigates over-all regional job schedules, obtains required engineering information and instructions, and sets job completion dates.

All mechanical orders initiated by process and others are reviewed, estimated and checked for proper coding by the planners. With assistance from others, they determine the types and quantities of materials required to maintain operating units in their region and are primarily responsible to see that all items are stocked by the Stores division or obtained on direct purchase requisitions as the situation requires.

Planners meet periodically with their region supervisor, field supervisors, process supervisors and engineering staff groups for coordination of the mechanical work effort in their region.

Region Schedulers (Maintenance Engineers and Construction Engineers)—Job plans developed by the planners are sent to region schedulers who arrange for and schedule craft manpower and industrial equipment required to perform mechanical work in their regions. A M&C schedulers' meeting is held at least once a week to discuss regional requirements, to receive priority jobs and policy from the chief scheduler, and establish a weekly manpower and equipment plan. Agreements are reached and the required action taken for the necessary transfer of men and equipment from one region to another. Each scheduler meets daily with his zone or field supervisors to develop necessary day to day variations of the weekly plan within his own region as necessitated by manpower availability, process requirements, job priorities, and the coordination of region activities with other region schedulers and the mechanical planning group.

Zone Supervisors and Job Superintendents—Zone supervisors and job superintendents consult with their region scheduler, region planner, field supervisors and process supervisors to formulate efficient daily and weekly mechanical work plans for handling maintenance, turnarounds and inspections, and construction jobs in their respective zones. Each zone supervisor and job supervisor directly supervises the field supervisors in his zone and coordinates work activities for the most effective use of available daily manpower. Other duties include the analysis of jobs to improve methods, techniques, tools and equipment, cooperation with craft general foremen to improve craft skills, resolution of corrosion or erosion problems with the Equipment Inspection division engineers, development and application of cost control methods and periodic review of mechanical costs with his region supervisor. The zone supervisor and job superintendent administrates all minor maintenance work requests and is responsible to his regional supervisor or construction superintendent for job progress and safety.

Field Supervisors—Field supervisors have the responsibility for maintaining all process equipment within their assigned area in efficient operating condition. They are the first line supervisors who direct all routine mechanical work performed in their areas. Each field supervisor is required to assign work and give job instruction to craftsmen assigned to his area and he is responsible to see that work is performed efficiently, safely and in keeping with good housekeeping practices. He ascertains that adequate tools, equipment and materials are available on the job. When a problem in craft know-how arises, a craft general foreman or training foreman is contacted for assistance.

Each supervisor works closely with the training foreman on matters of craft training. Grievances, disciplinary matters, daily up-rates, absenteeism, safety rules and interpretations of company policies and management and union contract are handled at their level whenever possible.

On such administrative matters, however, they may seek assistance from or refer problems, whenever necessary, to the craft general foremen. Field and zone supervisors determine manpower and job-time requirements for emergency and minor maintenance jobs. Together with zone supervisors, field problems are solved, new job methods developed, and work standards improved. Payroll time and job distribution charges are prepared by these first line supervisors for all hourly rate employees assigned to their areas.

CRAFT DIVISION

The Craft Division—Exercises administrative supervision over and is responsible for the skill of the mechanics in the crafts ascertaining that the men are properly trained, have modern tools and materials, and work safely and efficiently. It is consulted in the handling of grievances, disciplinary matters, uprates, and absenteeism, and in the interpretation of company policy to their craft, safety rules and the union contract. They advise field supervisors and regional supervisors in determining manpower and job-time requirements, craft skills and techniques.

In addition the Craft division is responsible for the administration of and scheduling work for the general refinery services group which include: field painters, masons, janitors, miscellaneous laboring services and transportation services.

Training foremen assist their general foremen in determining current training needs and develop and administer the necessary training programs for their craft. They work closely with field supervisors for the proper assignment of trainees and to expedite "on the job" training. Related classroom training is also handled by these foremen. For coordination and adequate standardization of the various phases of craft training programs the training foremen keep in close touch with the training coordinator.

Each foreman keeps the field supervisors and general foremen fully acquainted with each trainee's progress and qualifications so that maximum utilization of the trainee's skills may be obtained. When questions on craft know-how are raised by field supervisors, the training foremen provide the knowledge and instructions required. Upon request the training foremen assist field supervisors in the determination of manpower tools, equipment and materials required for jobs.

General foremen are assisted by the training foremen in the development of improved work standards and practices, and continually evaluate the efficiency and safety of craft tools and equipment. When improved craft methods are to be adopted as a

Esso's Mechanical Department . . .

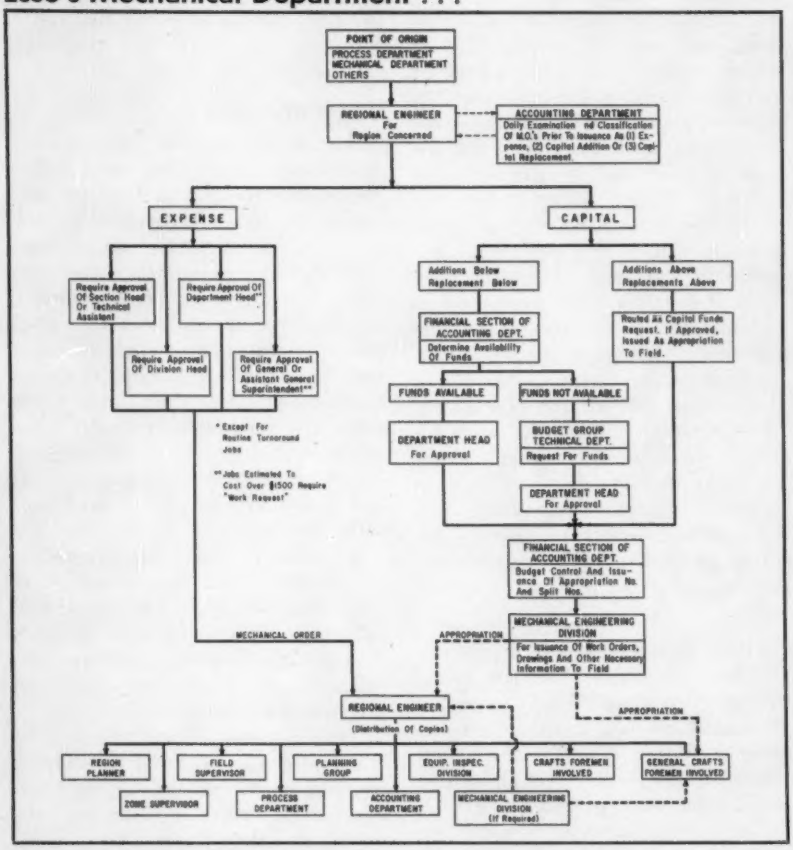

POINT OF ORIGIN
PROCESS DEPARTMENT
MECHANICAL DEPARTMENT
OTHERS
REGIONAL ENGINEER For Region Concerned
ACCOUNTING DEPARTMENT
Daily Examination nd Classification Of M.O.'s Prior To Issuance As (1) Expense, (2) Capital Addition Or (3) Capital Replacement
EXPENSE
CAPITAL
Require Approval Of Section Head Or Technical Assistant
Require Approval Of Department Head**
Require Approval Of Division Head
Require Approval Of General Or Assistant General Superintendent**
* Except For Routine Turnaround Jobs
** Jobs Estimated To Cost Over $1500 Require "Work Request"
Additions Below Replacement Below
Additions Above Replacements Above
FINANCIAL SECTION OF ACCOUNTING DEPT.
Determine Availability Of Funds
Routed As Capital Funds Request. If Approved, Issued As Appropriation To Field.
FUNDS AVAILABLE
FUNDS NOT AVAILABLE
DEPARTMENT HEAD For Approval
BUDGET GROUP TECHNICAL DEPT.
Request For Funds
DEPARTMENT HEAD For Approval
FINANCIAL SECTION OF ACCOUNTING DEPT.
Budget Control And Issuance Of Appropriation No. And Split Nos.
MECHANICAL ENGINEERING DIVISION
For Issuance Of Work Orders, Drawings And Other Necessary Information To Field
MECHANICAL ORDER
APPROPRIATION
APPROPRIATION
REGIONAL ENGINEER
(Distribution Of Copies)
REGION PLANNER
FIELD SUPERVISOR
PLANNING GROUP
EQUIP. INSPEC. DIVISION
CRAFTS FOREMEN INVOLVED
GENERAL CRAFTS FOREMEN INVOLVED
ZONE SUPERVISOR
PROCESS DEPARTMENT
ACCOUNTING DEPARTMENT
MECHANICAL ENGINEERING DIVISION (If Required)

FIGURE 2—Work order flow sheet: It originates with the process department.

standard procedure, the training foreman prepares written instructions, procedures or outlines on the proper use of tools and equipment.

The Shops Division—The Shops division supplies the necessary shop services for the Maintenance and Construction divisions. It is responsible for meeting field demands for shop service and to inform the Maintenance and Construction divisions as to the status of fabrication and repair work being done by the Shops division.

The shops are centrally located with a zone supervisor for the light equipment trades shops, (machine shop, pump repair shop, instrument shop, carpenter shop, electrical shop and garage) and a zone supervisor for the heavy metals trades shops (boiler shop, welding shop, tin shop, lead shop, pipe shop, pipe fab. shop and exchanger shop).

A service center group, headed by a zone supervisor, supplies the services of the electrical line gang, plumbers, tinsmiths, leadburners and sign painters whose services are better centrally controlled although they work throughout the refinery. Also handled by the service center group are the Mechanical departmental functions such as equipment record keeping, preventive maintenance follow-up; control, storage of and issuance of large craft tools and spare process equipment such as exchangers, pumps, motors, etc.

Stores Division—The Stores division is a service division organized to keep the refinery supplied with necessary material for efficient operations. The division is charged with the control of stock inventory so that a minimum inventory value is maintained consistent with good operations. It is also responsible for the receiving, storing and delivery of all materials and tools for the refinery. In addition to maintaining a central storehouse, there are also sub-stores located in each maintenance region to provide the every day demands of miscellaneous stores and tools. The division is also responsible for the sale of scrap and obsolete and surplus equipment.

Planning Scheduling—Mechanical work is separated into three categories:

- **Minor Maintenance**—Jobs requiring less than 10 man-days that can be efficiently planned on the job and executed on receipt of *Minor Work Order.*
- **Major Maintenance**—Inspections, turnarounds, dismantling projects over 10 man-days requiring coordination and planning. *Mechanical Order.*
- **Construction**—All construction work regardless of size.

The initiation of a request for maintenance or construction work usually originates in the Process department. Here a *Mechanical Order* is prepared which follows the route outlined in Figure 2.

Although each prepared mechanical order form contains an estimate of craft manpower and dollar expenditure, more accurate craft estimates are required to prepare a schedule of work and allocation of manpower. This is done by the maintenance and construction engineer who prepares a *Project Schedule,* outlining the operations, the schedule, and the number of craftsmen required. This major maintenance manpower requirement is added to the minor maintenance requirement (usually a minimum maintenance force for each region) in priority sequence until all the available maintenance craftsmen are allocated. This is done on Wednesday for the succeeding week. The jobs to be worked are typed on a *Mechanical Manpower Planning Distribution* form and men are assigned to jobs and field supervisors by a punch card system and a *Mechanical Payroll Time* printed by an automatic business machine.

At the end of each day the field supervisor prepares the distribution of craft manpower by confirming or taking exception to the plan. The field supervisor also confirms or takes exception to the payroll form in case men are absent or otherwise off the job. Thus the job and manpower planning data are used for cost distribution and the manpower assignment sheet is used to confirm a preestablished automatic payroll system.

ACKNOWLEDGMENT

This article was prepared by members of the Mechanical department, Bayway Refinery, Esso Standard Oil Company, Linden, N. J.

Keep Inspection Records the Easy Way

MAINTENANCE

A small refinery shows how to modernize your record-keeping system.

J. P. Chamberlain
Delta Refining Company, Memphis, Tenn.

HAVING TROUBLE keeping inspection records? Perhaps this system will be of help. The Delta Refining Company's plant is a small, modern independent refinery. Like many other independents, Delta utilizes the services of outside inspectors to augment personnel during a turnaround. Inspectors from licensors perform nearly all the metal loss inspections with the expection of the crude unit. This unit is inspected by refinery forces.

The record system is this: We maintain all of our inspection files on 12 inch by 18 inch tracing paper which is readily reproducible. Prior to each inspection, three copies of the inspection sheet covering each item of equipment to be inspected are run off and given to the inspector. One copy to serve him as a field sheet, one copy for his files and one copy to be filled in with his findings and submitted to the refinery as part of his inspection report. Each sheet shows the inspector at a glance the pertinent data covering the piece of equipment such as material, operating and design pressure and temperatures, in addition to all the past inspection findings. This data is very helpful to any new inspector who may come to the plant. It provides him with a drawing of the equipment and brings him up to date on the past history of the equipment. Although we attempt to obtain the same inspector each time, this is not always possible.

Before elaborating on the above system, it will be helpful to give a thumbnail sketch of Delta's refinery.

The processing units consist of a 6000 b/d, three tower crude unit, a 2700 b/d Thermofor Catalytic Cracking Unit complete with vacuum feed preparation and gas concentration, as well as a 600 b/d polymerization unit. Delta has the normal auxiliaries which go with a refinery of its size; namely, electric desalter, two induced draft cooling towers, three boilers, both a truck and rail loading dock as well as a river barge terminal in addition to the tank farm with its associated piping.

A sweet mixed base crude is processed which reduces the corrosion problem but this decrease is partially offset by increased erosion in the Catalyst circulation system of the "cat cracker."

Meet the Author

J. P. CHAMBERLAIN is chief engineer for Delta Refining Co., Memphis, Tenn. Here he has charge of design, maintenance and construction. He graduated in 1947 from the University of Wisconsin with a B.S. degree in mechanical engineering. Prior to joining Delta he had ten years diversified petroleum refining experience with Standard Oil Co. (Indiana), The Pure Oil Co., and Derby Oil Co. Chamberlain is a registered professional engineer in Kansas and Tennessee.

Synthetic Tower—Figure 1 is a typical inspection sheet for a fractionator. This particular drawing shows the Synthetic Tower on the TCC Unit. The data for this sheet was taken from the manufacturers shop drawing and from his "speck" sheet. Please note that an inspector who is completely unfamiliar with the Delta plant could take this one sheet and from it learn the thickness of the shell and heads, number of trays, size of tower, number and size of nozzles and manholes as well as pertinent operating data. For purposes of recording minimum thickness readings boxes are provided; one for both top and bottom heads, the shell section between each tray as well as one for recording the minimum reading of each nozzle.

Some inspectors will disagree with this type of sheet and say that there is insufficient space to record inspection data. This is true, space is limited; but, the lack of space requires that only pertinent data be recorded and thus makes for easier reading. Also by having thickness readings in a tabular form, rates of corrosion can be established. Any additional information or comment that is desired is covered in a turnaround "Maintenance and Inspection Report." This report prepared after each inspection covers work completed and recommendations for future repair or replacement.

The section in the November, 1955 Maintenance & Inspection Report covering the Synthetic Tower reads as follows:

Keep Inspection Records the Easy Way . . .

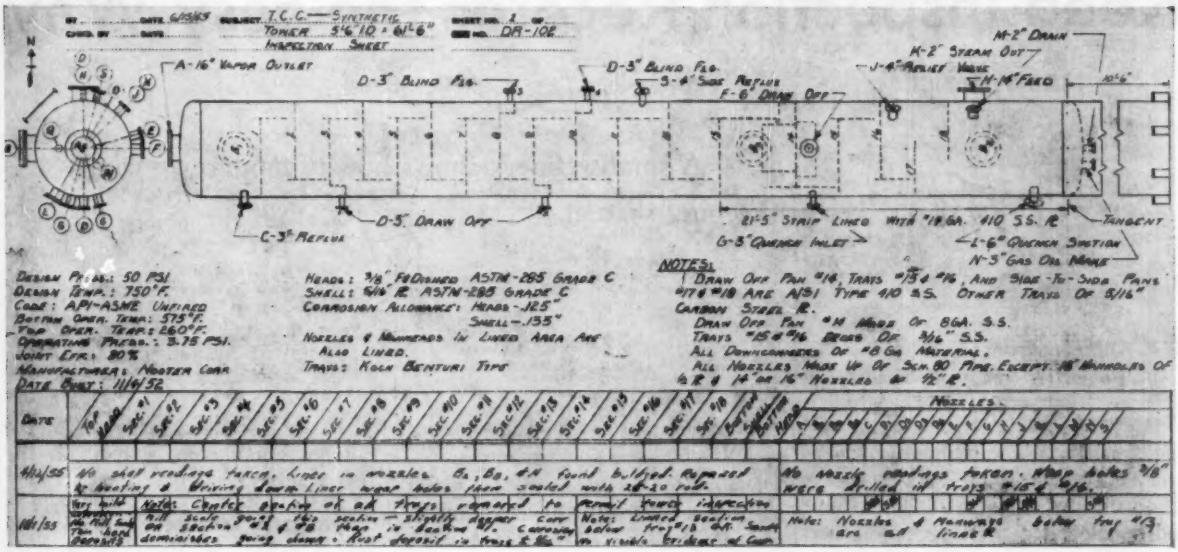

T.C.C.—Synthetic
Toner 5'6 I.D. x 61'6"
Inspection Sheet
DR-102
A-16" Vapor Outlet
D-3" Blind Flg.
D-3" Blind Flg.
S-4" Side Reflux
F-6" Drain Off
J-4" Relief Valve
M-2" Drain
K-2" Steam Out
M-14" Feed
C-3" Reflux
D-3" Drain Off
21'-5" Strip Lined with 18 GA. 410 S.S. R.
G-3" Quench Inlet
L-6" Quench Section
N-3" Gas Oil Make
Tangent
Design Press.: 50 PSI
Design Temp.: 750°F.
Code: API-ASME Unfired
Bottom Oper. Temp.: 575°F.
Top Oper. Temp.: 260°F.
Operating Press.: 3.75 PSI.
Joint Eff.: 80%
Manufacturer: Hooten Corp.
Heads: 3/8" F&D Dished ASTM-285 Grade C
Shell: 5/16" R. ASTM-285 Grade C
Corrosion Allowance: Heads-.125"
Shell-.135"
Nozzles & Manheads in Lined Area Are Also Lined.
Trays: Koch Bentuni Type
Notes:
Drain Off Pan #14 Trays #13 & #16, and Side-To-Side Pans #17 & #18 are A.I.S.I. Type 410 S.S. Other Trays of 5/16" Carbon Steel R.
Drain Off Pan #14 Made Of 8 GA. S.S.
Trays #15 & #16 Beams Of 3/16" S.S.
All Downcomers Of #8 Ga Material.
All Nozzles Made Up Of Sch. 80 Pipe. Except 18" Manholes Of 1/2 R & 14" or 16" Nozzles Of 1/2" R.
Data Sheet: 11/16/52
Date
Nozzles
4/04/55
4/0 shell readings taken. Lines in nozzles B2, B3, & N found bulged. Repaired by beading & driving down liner wear holes from scaled with 28-20 rod.
No nozzle readings taken. Wear holes 3/8" Nece. drilled in trays #15 & 16.
10/1/55
Very little corrosion was found on the Top head. Deposits
Note: Center portion of all Trays removed to permit visual inspection
Note: Nozzles & Manways are all lined R
Below tray #13

FIGURE 1—Fractionator inspection sheet shows thickness readings in tabular form.

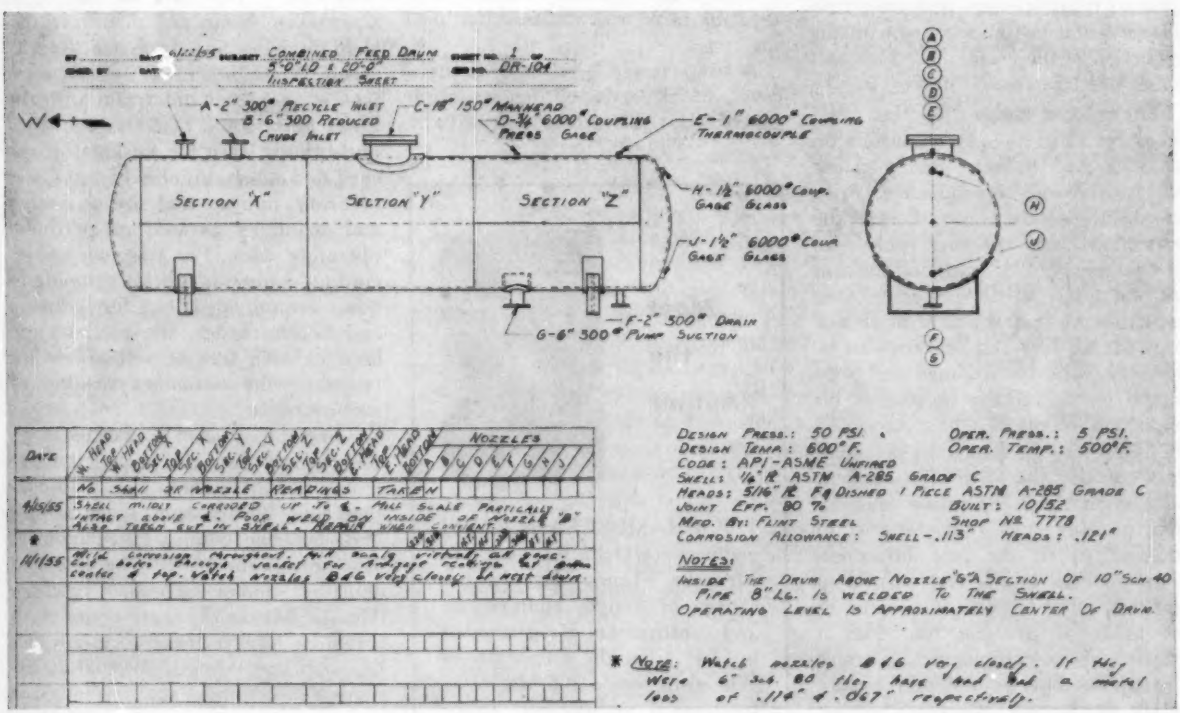

Combined Feed Drum
9'-0" I.D. x 20'-0"
Inspection Sheet
DR-104
A-2" 300# Recycle Inlet
B-6" 300 Reduced Crude Inlet
C-18" 150# Manhead
D-¾" 6000# Coupling Press Gage
E-1" 6000# Coupling Thermocouple
H-1½" 6000# Coup. Gage Glass
J-1½" 6000# Coup. Gage Glass
Section "X"
Section "Y"
Section "Z"
F-2" 300# Drain
G-6" 300# Pump Suction
Date
Nozzles
4/05/55
Shell mildly corroded up to ¼. Mill scale particles intact above & poor weld on inside of nozzle "B" area torch cut in shell. Manhole weld sound
11/1/55
Mild corrosion throughout. Mill scale intact above & below liquid level. Recond vessel for average reading of bottom center & top. Watch nozzles B46 very closely as most down
Design Press.: 50 PSI
Design Temp.: 600°F.
Code: API-ASME Unfired
Shell: 1/2" R. ASTM A-285 Grade C
Heads: 5/16" R F&D Dished 1 Piece ASTM A-285 Grade C
Joint Eff.: 80 %
Mfd. By: Flint Steel
Corrosion Allowance: Shell-.113"
Oper. Press.: 5 PSI.
Oper. Temp.: 500°F.
Built: 10/52
Shop No. 7778
Heads: .121"
Notes:
Inside The Drum Above Nozzle "G" A Section Of 10" Sch 40 Pipe 8" Lg. Is Welded To The Shell.
Operating Level Is Approximately Center Of Drum.
* Note: Watch nozzles B46 very closely. If they were 6" Sch. 80 they have had a metal loss of .114" & .067" respectively.

FIGURE 2—Accumulator inspection sheet indicates shell thickness and operating data.

Tower Inspection—"This tower was opened and the center section of each tray was removed to permit complete inspection of all trays. The tower shell and all tray decks were relatively clean and showed light corrosion. No work other than cleaning was required.

There was a small amount of catalyst fines in the seal pans on those trays near the bottom of the tower below the side reflux connection. The bottom of this tower was cleaned as well as the two side to side pans. Underneath this tower the 2 inch screwed drain line was backwelded from the tower nozzle to and including the first valve. Also a brace was

installed under this line.

The tower relief valve was removed and taken to the shop and its setting checked."

Now compare the information on the tower inspection drawing with that outlined in the above quoted report. You will see that with the exception of the backwelding of the drain line and the checking of the relief valve all other data is given on the inspection sheet in more detail but in much less space.

Accumulator—Figure 2 is a typical inspection sheet for an accumulator. This particular one is the TCC feed preparation Combined Feed Drum. Again you will see that all of the shell thicknesses as well as design and operating data are given. On this vessel two nozzles are getting thin. Note that an asterisk was placed in the date column to call special attention to this sheet. Also a note giving additional data was added. Under "11/1/55" a recommendation is made that spot insulation be removed from bottom, center, and top for thickness readings.

Piping System—Figure 3 shows an inspection sheet for pipe. This particular sheet shows line BP-8 which is the vapor feed line from the Tar Flash Tower to the TCC Reactor. The piping sheets are made slightly different from those for pressure vessels. As you can see, the sheet shows a schematic of the piping system. On this schematic are indicated points where readings are taken. These points are indicated by a letter in a circle with an arrow pointing to the point on the pipe. In the tabular section the thickness readings are recorded under the proper date in the column adjacent to the location letter. On all piping drawings the first date column is marked "Original" and consists of pipe thicknesses corresponding to the average thickness of new pipe of proper schedule as specified at the time of erection. This average thickness is used in lieu of actual original readings as no thickness readings were taken during erection.

Most of the pipe thickness readings taken in the Delta refinery are obtained by means of a penetron. Spots which are found thin are then checked by drilling to verify penetron readings.

Again refer to Figure 3. You will note that thickness readings appear

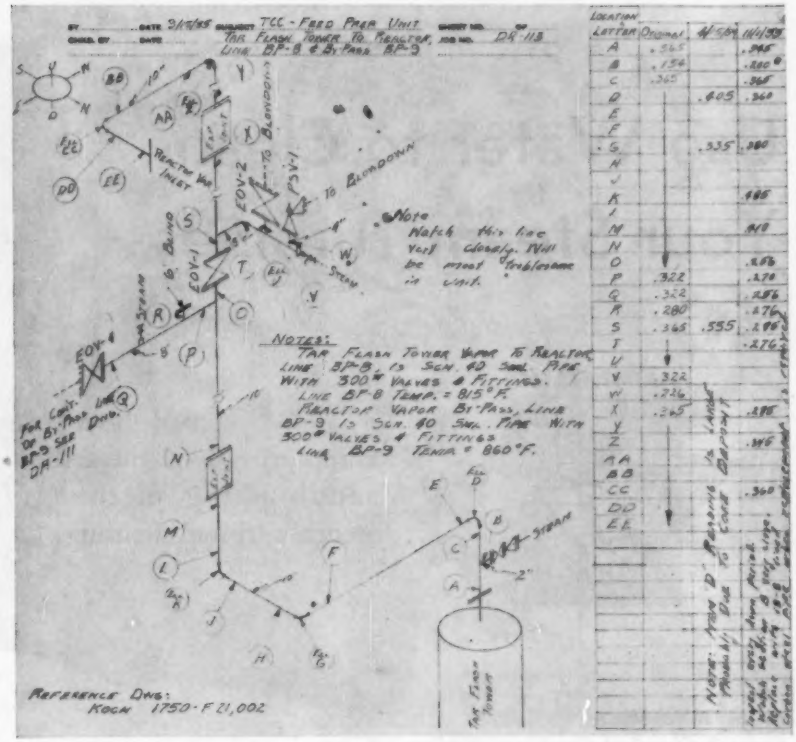

TCC - FEED PREP UNIT
TAR FLASH TOWER TO REACTOR
LINE BP-8 & BP-9 PREP BP-9
DR-113
Note
Watch this line very closely. Will be most troublesome in unit.
NOTES:
TAR FLASH TOWER VAPOR TO REACTOR LINE BP-8 IS SCH. 40 SMLS. PIPE WITH 300# VALVES & FITTINGS.
LINE BP-8 TEMP. = 815°F.
REACTOR VAPOR BY-PASS LINE BP-9 IS SCH. 40 SMLS. PIPE WITH 300# VALVES & FITTINGS
LINE BP-9 TEMP. = 860°F.
REFERENCE DWG:
KOCH 1750-F 21,002
LOCATION LETTER
ORIGINAL
11/1/55

FIGURE 3—Piping inspection sheet gives original pipe thickness and inspected thickness.

to be erratic. This is probably due to one of two things. First there may be coking in the line and second, Sch. 80 pipe was apparently mixed with Sch. 40 pipe at the time of erection. Also on this drawing a note has been added calling attention to the fact that this line will be the most troublesome in the entire unit and should be watched very closely.

The three copies of the inspection sheets shown are merely examples of the system; similar sheets covering every item in the refinery could be prepared should such a complete inspection record be required. Delta does not maintain this although in addition to aforementioned items records on exchangers and furnaces are maintained. Sheets covering pressure parts of exchangers and furnaces were not included with the typical sheets as all refiners are familiar with the standard methods of recording such data. Delta's system for these items differs from the standard only in that these records are maintained on tracing paper.

Actual Inspection—It may be interesting to note that during the actual inspection, the outside inspectors are given complete freedom of the non-operating processing units. They are requested to inspect specific items but are encouraged to inspect every item of equipment that is open and to take as many thickness readings as possible even though an inspection sheet was not previously provided. Quite frequently the inspector will ask for a sheet on some particular pipe line or piece of equipment which he thinks should be inspected. If no inspection drawings are available, field notes and sketches are made. Inspection sheets on tracing paper are then prepared when time permits. Following the inspection, the outside inspector will submit in addition to his regular inspection report a copy of the inspection sheets showing thicknesses as have been previously described. Upon receipt of these outside reports, the essential data from them is recorded on the original inspection sheets. After transcribing the report, which can be completed in approximately eight hours by one man, the original field notes and outside inspectors reports are filed with a copy of the Maintenance and Inspection Report under the appropriate date. ##

Use Water to Clean Your Steam Turbines

MAINTENANCE

Here's how one company solved the tedious sandblasting method of steam turbine cleaning.

M. M. Mitchelson
Spencer Chemical Company, Pittsburg, Kansas

BECAUSE OF THE critical relationship between the power source and operations of the plant, maintenance of the turbo-generators is a problem always under study for methods which will reduce down time to a minimum.

The practice at Spencer Chemical Company's Jayhawk Works, in taking down steam turbo-generators for the annual inspection, was to remove the rotor and nozzle blocks and sandblast or scrape the steam deposits by hand.

The deposits prevented the machine from operating at full rate during the period just preceding the annual inspection. Upon investigation, most of the deposited material was found to be water soluble and the possibility of removing them by washing with water without disassembling the units, seemed good.

The turbines are condensing extraction type, 5000 KW, 3600 revolutions per minute, 13 impulse stages, extracting 125,000 pounds per hour of 275 psig steam at 540 F., between the 2nd and 3rd stages. The remaining flow goes through the eleven remaining stages into a jet condenser. The inlet steam is supplied by five 4-drum type steam generators rated at 180,000 pounds per hour at 625 psig at 740 F. each.

Dissolved Solids—The total dissolved solids in the boilers are kept at approximately 2250 ppm, and the alkalinity at a minimum of 200 ppm. Sodium hydroxide is injected into No. 3 drum to maintain the minimum alkalinity. The carry-over from the boilers, consisting mainly of sodium phosphate, is being deposited in the turbines.

Approximately 290 man-hours were required to remove the case and rotor, clean off the deposits, and re-assemble the machine. Twelve men were about the maximum crew that could work efficiently around a turbine of this size; assuming a 12 man crew, it would take three eight hour shifts. If they worked around the clock, the turbine would be off the line for 24 hours, the very minimum time.

If supervision and manpower were available only for the day shift, then assuming 12 hour shifts, the machine would be down for 36 hours. In this case a saving of 28 hours down time would be saved by washing instead of disassembling and cleaning off the deposits by hand. The most important item, neglecting down time, was the 290 man-hours saved. In the washing operation, only the regular maintenance and operating personnel were required to do the job.

Removal of Deposits—The insoluble deposits were removed by sandblasting at the time the machines were down for the annual inspection. The silica deposits, for example, adhered so tightly to the metal surfaces that removal had to be done by sandblasting or by hand. The case and rotor were removed for inspection and possible replacement of labyrinth packing and bearings. The time required for removing the deposited material at this time, could be charged only to the actual hours required to do the job and not to any disassembling, assembling or down time.

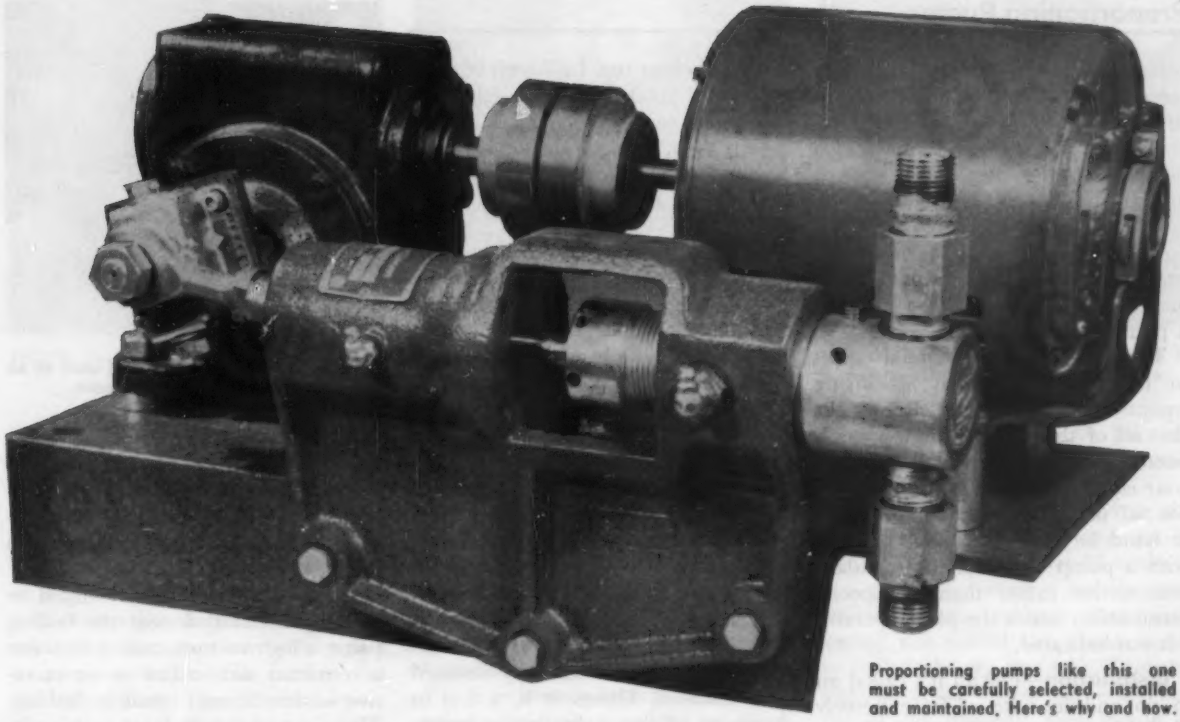
The method selected for washing was to use 15 psig saturated steam injected into the opposite end of the steam chest from the throttle. This point of admission prevented disturbing the high pressure steam inlet, so that the turbines would be started in the normal manner.

Once rotation had been started, the throttle would be closed and the low pressure steam would keep the turbine rolling at any desired speed depending upon the condenser vacuum. The low pressure steam was supplied by a three-inch line connected to an unlimited supply. The procedure for washing was as follows:

Turbines—The turbines were allowed to cool for approximately 5 hours after being taken off the line, then were started rolling with high pressure steam. After the speed had been brought up to approximately 200 rpm, the high pressure steam was shut-off and the 15 psig steam admitted. The machines were run for three hours at a speed of not more than 1000 rpm, the speed being controlled by the condenser vacuum. If time would permit, the machines were run longer than three hours on low pressure steam. Generally, the load would not permit the turbines to be down for a longer period of time.

In most instances, after this period of washing, the machines would take full load, although all of the water soluble deposits were probably not removed. The turbines were taken down for washing any time after the load on the machines fell 25 percent, if load conditions in other parts of the plant permitted.

After cooling and washing for the eight-hour period, enough of the deposited material was removed to permit the turbines to operate at full load. ##



Proportioning pumps like this one must be carefully selected, installed and maintained. Here's why and how.

Your proportioning pump requires . . .

An Ounce of Preventive Maintenance

The precision of the diminutive proportioning pump is in danger unless care is given to installation and preventive maintenance.

E. R. Franklin
Proportioneers, Incorporated
Providence, Rhode Island

THE SUCCESS, or failure of a process often leans heavily on the skill and care exercised in installation, operation and maintenance of a piece of equipment now assuming an increasingly important role, the diminutive proportioning pump. These small precision pumping instruments designed to precisely control the flow and handling of liquid chemicals are rapidly taking over the job formerly held by batch mixing processes and replacing it with "in-line blending." Because the entire process depends on their functioning with the dependability and high accuracy built into them by the manufacturer it is extremely important that proper care be exercised in their use from the time the crate arrives at your plant.

In the petroleum industry they're finding wide use as sampling pumps, acid treating, inhibitor injection and in dozens of other applications requiring the precise handling of liquids. They're widely used in power plants for the handling of boiler chemicals; they are finding extensive use in the treatment of cooling waters. All of these applications depend heavily on proper installation and maintenance. Unless care is given to the method of installing this equipment and a preventative maintenance routine established, the precision which the plant operator originally purchased and which the manufacturer designed into the equipment will be for naught.

Specifying—Perhaps the first step to be taken to assure that your proportioning pumps deliver everything that you expect of them is to make certain that they are correctly applied. Because these pumps are called on to handle practically every known liquid they are made up in just about every known alloy. They are called on to operate under a wide variety of

conditions and hence are manufactured in a number of different constructions.

Nothing will cause breakdown of a plant's control system faster than a mis-applied pump. It's not enough to specify "Service—water-like clear liquid." Full details of the liquids to be handled must be furnished if the manufacturer is to intelligently design a pump for your specific service.

Table 1 covers the essential points to be considered when specifiying equipment of this nature. Remember that all of these points are extremely essential to the firm which furnishes your equipment. If the manufacturer has *all* of the available information at hand he very often can come up with a pump of completely standard construction rather than the special construction which the plant operator felt was indicated.

Installation—For all it's called on to do and in spite of its extremely high degree of accuracy proportioning pumps are amazingly simple, basic, rugged pieces of equipment. It is extremely important however that a few basic but simple recommendations be followed when installing them.

The pump itself should be installed on a solid concrete or steel base and securely bolted or lagged down. It should *not* be grouted in if installed on a concrete base. If installed in a hazardous atmosphere it may be necessary to move it to another location for repairs. Chipping the pump baseplate out is time consuming and expensive. Use of a pneumatic hammer to remove it can result in damage to the pump base and the concrete dust raised may well result in damage to the pump bearings. In the event of an in-process breakdown, such delays are extremely costly. When installing the pump then, thought should be given to facilitating its removal if necessary to perform repair work on it in another area.

TABLE 1

	Max.	Normal	Min.
1. Type of Pump—Simplex—Duplex—Etc.			
2. Capacity—GPH/CYL			
3. Discharge Pressure PSIG			
4. Suction Pressure PSIG 4A—(Suction Lift Feet)			
5. Temperature of Fluid Pumped			
6. Fluid Pumped (Trade Name or Chemical Formula—			
7. Concentration—			
8. pH —			
9. Viscosity—			
10. Specific Gravity—			
11. Suspended Solids:			
Lbs. per Gal.—			
Percent—			
Micron Size—			
Abrasive? —			
12. Preferred Materials of Construction:			
Cylinder—			
Plunger—			
Valve Trim—			
Packing—			
13. Drive:			
Available Current—			
Motor Enclosure—			

Adequate clearance must be given to permit removal of such items as liquid ends, speed reducers and motors. Suction and discharge piping should be fitted with companion flanges or unions close to the suction and discharge port. If necessary to remove the liquid end it can then be done without removal of piping. The piping itself of course must be self-supporting to preclude any possibility of strain being placed on the pump. Such strain can very easily result in mis-alignment of the entire pump.

Careful thought must be given during installation to make certain that the piping system is carefully designed and installed. Unless it is, a loss in pumping efficiency, but more important a considerable loss in accuracy, will result. Most of these pumps are designed to operate within accuracies of plus or minus 1 percent. An incorrectly designed or installed piping system will result in completely cancelling out the pump's most important function—accuracy.

A strainer of the self-cleaning type must be installed wherever possible. Proportioning pump check valves are small—clearances held to a minimum. The possible exception to this would be the handling of slurries and in these cases the pump is furnished with a liquid end specifically designed for this service. Remember, this is a precision pumping *instrument*. Foreign matter *must* be kept out of the liquid end.

Suction piping should be kept as short as possible and should contain no restrictions. If excessive friction is caused by lengthy runs of suction line or under-sized piping accuracy can be greatly affected. The number of fittings used must be kept to a minimum to further insure that excessive friction will not result. Every effort should be taken to provide a flooded suction. Because of their high volumetric efficiency and sharp valve action these pumps can effectively operate with a negative head. However this always introduces the possibility of air entering the system. Because of the vacuum

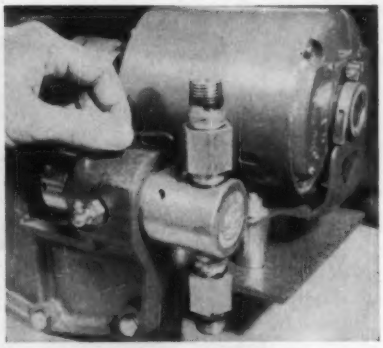


FIGURE 1—Pump must be vented until no air is detected at the vent point.

required to lift the chemical being handled, air can enter the suction line if any leaks are present. If the packing is not installed and adjusted correctly air can enter through the pump itself.

In the case of a volatile liquid or any liquid handled near the boiling point, a high vacuum caused by either a restricted suction line or an excessive suction lift may result in flashing. That is, vapor will form within the liquid head. The vapor caused by flashing, or the air which may have entered the cylinder through packing or the suction line, will cause a considerable loss of accuracy. Further this condition may well result in water hammer, particularly in large bore pumps operating at high stroking rates. This water hammer can cause very severe damage to the pump mechanism. The hammer is caused by the plunger moving forward through its discharge stroke in a liquid end only partially filled with liquid. When the air or vapor in the cylinder is displaced the plunger meets the relatively non-compressible liquid. The resultant shock carried back to the driving mechanism has been known to fracture pump connecting rods.

Equal care must be taken with the discharge piping. Again this piping must be adequately sized although in this case for somewhat different reasons than previously discussed for the suction system. Undersized piping can well result in excessive back pressure. This is particularly true when handling viscous liquids. In addition to creating excessive back-pressures, undersized discharge piping may cause over feeding due to excessive discharge line velocities. If the velocity of the liquid in the discharge line is too high the resultant inertia will cause the pump to over feed. Positive

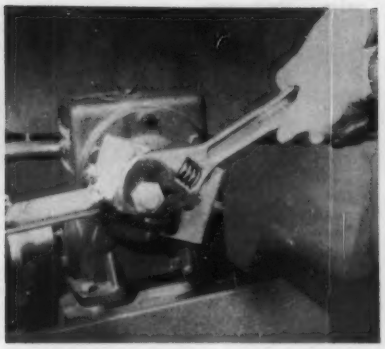


FIGURE 2—Loosen crank pin lock nut to change stroke length.

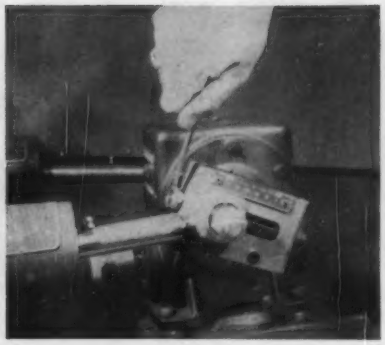


FIGURE 3—Stroke length and delivery is set with adjusting screw.

FIGURE 4—Liquid head can be removed by backing-off the packing gland follower.

displacement proportioning pumps are made up of one or more single acting cylinders. If discharge velocities are high enough the liquid being pumped will tend to continue flowing through the pump *after* completion of the discharge stroke.

Complete instructions are given by the pump manufacturer with regard to properly sizing both suction and discharge lines. These recommendations must be very closely adhered to if optimum results are to be expected.

A relief valve must be installed as closely as possible to the discharge valve. This valve *must* be installed before any shut-off valves. It's a natural tendency to pipe the discharge of this relief valve back to the pump suction line. While this is effective as far as protecting the pump is concerned, it does make it difficult to determine whether or not the relief valve is leaking. Proportioning pumps are usually small capacity and a small leak in a relief valve will often times pass more liquid than the pump is capable of delivering. The relief valve discharge should be piped back to the top of the solution tank in such a manner that any leakage can be readily detected.

Proportioning pump liquid ends are designed with extremely close volumetric clearances. Foreign matter such as pipe chips can damage the plunger or render the check valves themselves inoperative. All connecting piping and tanks must be thoroughly cleaned before connecting a pump such as this to the system.

Before starting the equipment up for its initial run it must be carefully lubricated. Motors are usually shipped lubricated and ready to go. Lubrication of these motors must be governed by the motor manufacturer's recommendations. The big warning here: *Don't over-lubricate!*

Many manufacturers ship their pumps equipped with speed reducers "ready to go." It must never be taken for granted however that the reducer as received is filled with oil. The oil level must always be double checked. If not up to the level plug, fill in strict accordance with instructions.

It is extremely important that the reducer be flushed and given an oil change after the initial run-in. Following this initial change of lubricant the oil should be changed periodically and the reducer lubricated as service conditions dictate.

A common cause of difficulty is speed reducer oil seal leakage. In almost all cases this is caused by failure to vent the reducer. Some reducers are shipped with the vent plugged—others are shipped with two caps, a shipping and vent cap. Failure to vent the reducer either by removal of the plug or replacement of the shipping cap with a vented cap will result in pressure building up within the housing as the reducer heats up to normal running temperature. This build-up of pressure will cause oil seal leakage.

In addition to other points such as the wrist pins, crank pins and crosshead, care must be taken to assure that the packing is properly lubricated prior to start up. Make doubly certain that the lubricant used for packing is one furnished for the specific chemical which the pump is to handle. Providing full service conditions have been made available to the manufacturer the pump is shipped with a lubricant properly compounded for the specific service to which the equipment will be subjected. Normal petroleum lubricants such as are used in bearings must *not* be used. The lubricant used and the lubrication schedule to be followed will depend wholly on the chemicals being handled.

Packing has been adjusted at the factory during the test and run-in period; however, the first 24 hours of "on the job" operation are the most critical. If any leakage does occur during this period the gland should be pulled up *very gradually*. Excessive tightening will cause premature failure of the packing. This should be attempted only while the pump is running. Types of packing vary widely with specific applications.

When first starting the pump it should be vented to remove all air from the cylinder. In some cases this is accomplished by a vent valve installed in the discharge line directly above the pump discharge port. Other pumps such as that shown in Figure 1 have a vent valve with a ball check arrangement built into the pump cylinder itself. In either case the pump must be vented until no air can be detected at the vent point.

Proportioning pumps are basically one of the simplest of all pumps manufactured. The majority of them are single acting plunger pumps—with a few refinements. One of the major refinements is the variable stroke feature. By varying the crank pin throw and the plunger stroke length the pump's capacity may be changed in direct proportion to the stroke length. Before changing stroke length the crank pin lock nut must be loosened as shown in Figure 2.

Stroke length and delivery is then set by adjustment with a stroke length adjusting screw as shown in Figure 3. In this case the scale is graduated in terms of percentage of full stroke length. Capacity at full stroke length is stamped on this scale and by reference to this and the percentage gradu-

FIGURE 5—Liquid head is removable for complete packing overhaul.

FIGURE 6—Valve retainer ring is removed.

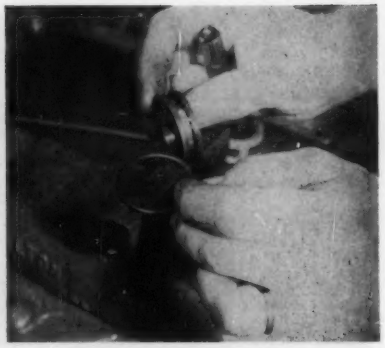


FIGURE 7—Valve seat is inspected for wear.

ations it's possible to preset pump delivery within very narrow limits.

After adjustment the lock nut must be re-tightened. Unless this is done the load placed on the adjusting screw when the pump is started will cause failure of the stroke adjusting mechanism.

The most vulnerable parts of a chemical pump are the plunger, packing and check valves. All must be maintained in top shape if you are to be assured of trouble-free performance. Removal of the liquid end greatly facilitates packing maintenance. Because proportioning pumps are generally rather small it is more difficult than with larger equipment to do a complete packing overhaul unless the liquid head is removed.

These heads are generally designed for ease of removal. Figures 4 and 5 illustrate the ease with which a head may be removed. The packing gland follower is backed off as in Figure 4. Following this the lubricant fitting which acts as a retaining plug is removed. The entire head can then be readily slipped away from the pump frame as shown in Figure 5.

All old packing *must* be thoroughly removed before the pump is packed. Don't overlook the packing rings forward of the lantern ring. The stuffing box should be repacked with the plunger in place. The manufacturer has available preformed rings of packing for your specific installation and application. Do not attempt to use packing of a type other than recommended by the manufacturer. Use of standard packings normally acceptable for such applications as water or oil can be extremely dangerous if used with some of the more corrosive acids.

Before placing the pump back in service, the plunger should be carefully inspected. If scored or worn, it must be replaced otherwise the new packing will fail very quickly.

Small check valves such as shown in Figure 1 are generally of the "throw-away type." That is, they are priced low enough so that it's more economical to replace only those parts which may be worn. After removal of the retainer as shown in Figure 6 the valve may be readily disassembled. In this case the components, the vane guides and seats, are "stacked." That is, they're held in place by the retainer. Other types of valve seats may be screwed in place or pressed in.

Usually pressed seats or valve components as shown in Figure 7 can be readily removed. If necessary to force them out they must be tapped or pressed with the aid of a length of brass bar stock. Use of any other material will result in damage to the valve seat. In the case of screwed seats a wrench specifically designed for this service must be used to remove the seat.

The seat should be carefully inspected for wear. If worn it must be replaced or reversed. The valve seat shown in Figure 7 is fully reversible. If worn on one side it need only be reversed when reassembling the check valve. Gaskets or O rings must be carefully inspected. If there is any question of their effectiveness they must be replaced.

All manufacturers maintain extensive records of their products. If necessary to contact the factory for advice, be certain that the serial number of the pump is given. This is especially true in ordering replacement parts. Equipment of this nature is manufactured in a variety of alloys, sizes, and other modifications. The serial number then is particularly valuable in positively identifying your equipment.

Before changing from one service to another the manufacturer should always be consulted. He has the exact engineering data on hand and can advise you whether the pump can be changed from one application to another. It may be necessary to modify it because of the corrosive effect of the new application. It may appear time-consuming to wait for this information, however it's far less costly and time-consuming than operating the pump on a service for which it was never intended with possible severe damage to the pump itself and even more costly—failure of a process.

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Meet the Author

EDWARD R. FRANKLIN is project engineer for Proportioneers, Inc., Providence, R. I. He graduated in 1938 from Wentworth Institute in Boston where he majored in thermodynamics and power plant engineering. Upon graduation from school he worked for two years as a watch engineer for Niagara Hudson Power Co., then following this he taught power plant engineering for two years at Wentworth Institute. During World War II he served for four years as a marine engineer with the Merchant Marine, joining Proportioneers, Inc., in 1946.

FIGURE 1—This Texas refinery uses both slip-type expansion joints and double-offset U-bends to absorb pipe line expansion and contraction. See next page for other types of expansion joints.

Expansion Joints
How to Select and Maintain Them

MAINTENANCE

If you are confused about all the types of expansion joints, here's a method of selecting and maintaining the right one for the job.

K. S. Roberts
Yarnall-Waring Company
Philadelphia

LARGE NUMBERS of pipe lines conveying steam, hot liquids and other fluids for refining and petrochemical processing must be fitted with some means to absorb expansion caused by a rise in the temperature of the pipe. There are also instances where means for absorbing pipe contraction must be provided, if the line is installed at a temperature higher than the minimum experienced in operation. Positive control of pipe expansion and contraction is absolutely necessary if dangerously large or destructive forces at the anchors and other restraints are to be avoided.

Three proven means for absorbing pipe expansion and contraction are popular in refineries and petrochemical plants today. These are: (1) expansion bends, (2) corrugated- or bellows-type expansion joints, and (3) slip-type expansion joints. This

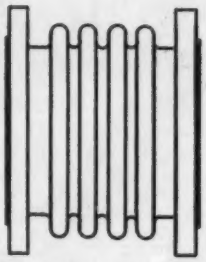


FIGURE 2—Simplified sketch showing a typical corrugated-type expansion. joint suitable for refinery piping systems.

FIGURE 3—Simplified sketch showing a hinge-type corrugated expansion joint suitable for refinery piping systems.

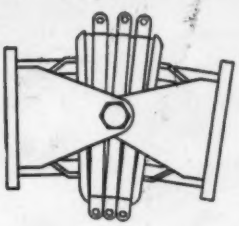
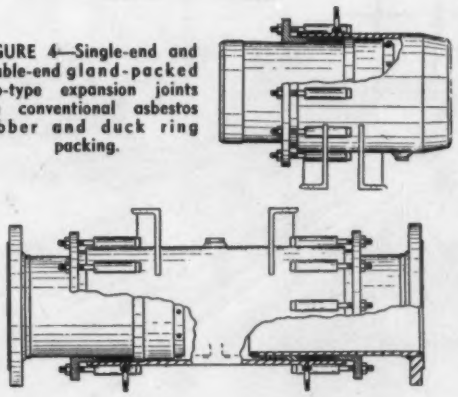


FIGURE 4—Single-end and double-end gland-packed slip-type expansion joints use conventional asbestos rubber and duck ring packing.



article discusses the relative merits of each, and the important factors in application to modern piping systems in refining and petrochemical plants.

Expansion Bends—These are made in several different shapes, depending on the amount of space available, size of the pipe, expansion or contraction to be absorbed, and the temperature and pressure of the fluid flowing through the pipe. In general, the more intricate the bend configuration, the greater the expansion that can be absorbed for a given stress in the pipe.

The common types of expansion bends used today are either fabricated or built-up. Fabricated bends may be simple U, double-offset U (Figure 1), circle, or single offset U. Creased bends, though once used to some extent, have become less popular in recent years. Built-up bends are made in a number of configurations from welding elbows.

Expansion bends require no routine maintenance if they are uninsulated. If the bend is insulated or fitted with a drip trap, or both, routine inspection of the insulation and trap is required.

All expansion bends, whether fabricated or not, require more installation space than either corrugated or slip-type expansion joints (Figure 1). This is often an important consideration in crowded refinery areas, but can usually be overlooked on tank farms and other locations where a large amount of space is available. Expansion bends are usually mounted vertically (Figure 1), or horizontally, depending on the amount of space available.

The first cost of a fabricated expansion bend may exceed the first cost of a bellows or slip-type expansion joint. A built-up expansion bend usually costs less than a fabricated bend or either type of expansion joint, unless a large amount of labor is required to build the bend.

Corrugated Joints—These joints consist of one or more corrugations in a metal suitable for the temperature and pressure in the pipe (Figure 2). Typical materials used for corrugated joints include copper, stainless steel, or Inconel in the bellows and cast-iron or cast-steel end flanges, or steel welding nipples.

The corrugated joint, when well designed and constructed, has advantages where the installation is inaccessible and maintenance of the joint is difficult or impossible. Corrugated joints do not require maintenance in the form of repacking or lubrication. However, the selection of a corrugated joint must take into careful consideration the extent and frequency of the cycles (degree and number of expansions and contractions) of operation anticipated in the life of the installation. Otherwise, the joint may fail prematurely due to overstressing the corrugations or bellows.

There are other advantages of the corrugated type. When made of stainless steel they can be used at temperatures beyond the range of slip joints; the latter are limited by packing and lubrication considerations. Stainless steel corrugated joints are excellent for handling corrosive fluids or fluids which must not be subject to contamination.

In very large sizes (over 30 inches) corrugated joints are easier to fabricate, transport, and install than slip joints. They are often used in large ducts and manifolds, particularly for high-temperature exhaust systems and other refinery applications. They are also useful when the piping is subject to lateral and angular misalignment, as well as axial motion, although here again it is important to select and install the joint properly so that the corrugations will not be overstressed.

In recent years corrugated expansion joints have been used increasingly as hinge, universal and gimbal joints. These are specialized applications of the bellows principle which have definite advantages for certain types of installations. One of the most useful is the hinge joint, Figure 3, which, when circumstances permit, can be used to absorb expansion without the need for anchors.

Slip-Type Joints—In spite of the versatility of the corrugated joint outlined above, the slip joint (Figure 4) has certain advantages which make it the choice for many refinery and petrochemical installations. When well designed it is a rugged, dependable, and economical means of absorbing expansion and contraction. It is particularly useful in steam and hot-water transmission lines where the expansions and contractions are frequent and of large magnitude. Slip joints contain no highly-stressed flexing element subject to failure after a finite number of cycles.

Slip joints require a nominal

amount of maintenance in the form of packing and lubrication. The exact amount of maintenance required depends largely on the operating conditions, i.e., temperature, pressure, expansion or contraction absorbed and frequency of operation. Probably the most objectionable feature of slip joints in the past has been the necessity for periodic repacking of the stuffing box, which entailed shutting down the line and considerable labor. In one unique and well established design—the gun-packed joint (Figure 5) packing can be inserted into the stuffing box at any time with full temperature and pressure on the line. This eliminates any shutdown and reduces maintenance time to a minimum.

Slip joints fitted with a sliding member at only one end are known as single-end joints. When sliding members are used at both ends, the joint can absorb twice the expansion of a single-end joint and is known as a double-end joint.

Where repacking under pressure is not a consideration, conventional gland-packed joints (Figure 4) may be used. These resemble gun-packed joints but have conventional asbestos or rubber and duck ring packing. Cast-iron glands are generally used, while the body and sleeve are wrought steel. The sleeve is polished and chromium-plated.

Gun-packed joints are of all-steel construction, the sliding sleeve being made of polished seamless steel with a layer of hard chromium plating. The sleeve is guided internally and externally for correct alignment in the stuffing box.

Packing, in joints of the type in Figure 5, is forced into the stuffing box by the jack action of a wrench-operated plunger threaded in a cylinder, as shown in Figure 6. The packing can be fed into the joint while the line is under pressure. The packing used is a semiplastic, heat-resistant, high-grade, long-fiber asbestos, combined with an inert filler and impregnated with high fire-test mineral oil. It is furnished in small slugs for easy insertion in the packing gun.

Joint and Bend Selection—When choosing any type of expansion joint or bend it is essential that a number of important factors be considered. These include the required traverse, operating temperature and pressure,

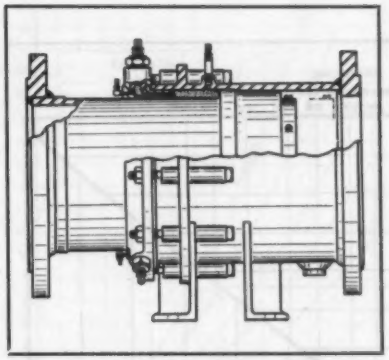


FIGURE 5—Single-end gun-packed type slip expansion joint. This is also built with double ends.

nature of the fluid, presetting, expansion, anchors, alignment, and supports. A number of these factors are discussed below.

Traverse—This is the distance, expressed in inches, that the joint or bend must contract in order to absorb the expansion of the pipe served by the particular joint or bend. The required traverse is numerically equal to the distance the pipe expands over its full temperature range. The lowest temperature that will be encountered is as important as the maximum temperature. This means that if the expansion tables available start at 70 F. (as some of them do) and the line is to be installed outdoors where winter temperatures can drop as low as 20 F. below zero, traverse must be provided to cover the additional 90 F. range below the reference temperature of 70 F.

The traverse of the joint or the bend is the maximum safe movement

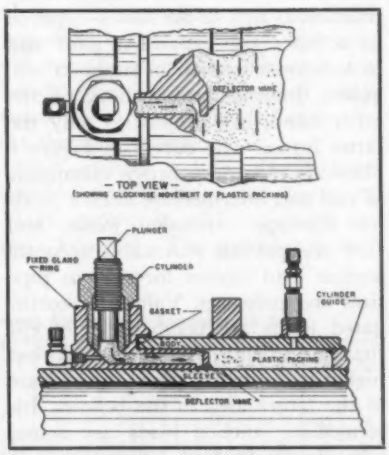


FIGURE 6—Wrench-operated plunger for feeding plastic packing to a gun-packed type expansion joint.

specified by the manufacturer. The numerical value of this traverse should always exceed the computed expansion of the pipe (i.e. the required traverse). Thus, with a 20-inch expansion a joint with a total traverse of 24 inches is usually chosen.

Presetting—Where traverse in both directions is expected, it is essential, when actually placing the joint, to preset it for the temperature of the pipe at the time of installation. With slip-type joints, the sleeve should be pushed in from its fully extended position a distance equal to or slightly greater than the distance the pipe will contract in going from the installation temperature down to the minimum temperature. For the example cited above, if the installation temperature is 70 F., the sleeve should be preset enough to accommodate 90 F. of contraction—or approximately one inch if the pipe is 100 feet long. Bellows joints are sometimes furnished in mid-position (halfway between the fully compressed and fully extended positions of the unit) to cover such conditions, but with all designs the manufacturer's installation instructions should be followed carefully.

The following actual case is an example of how important contraction can be. Expansion joints were installed, fully extended, in a pipe line in a tunnel where the temperature was close to 100 F. The line was well supported and rigidly anchored to the tunnel wall with through bolts and backing plates. In accordance with good practice, the system was given a hydrostatic pressure test prior to putting it into steam service. However, the hydrostatic test water came from a deep well at a temperature between 40 and 50 F., and the pipe contracted with unfortunate results. The pipe anchors were literally pulled out of the wall. Obviously, the trouble in this case was not that the anchors were inadequate but that no provision had been made for contraction of the pipe.

Pipe Expansion—Figure 7 shows the expansion of steel pipe for any temperature up to 700 F. For convenience, one scale also provides the saturation temperatures for various steam pressures. Given the tempera-

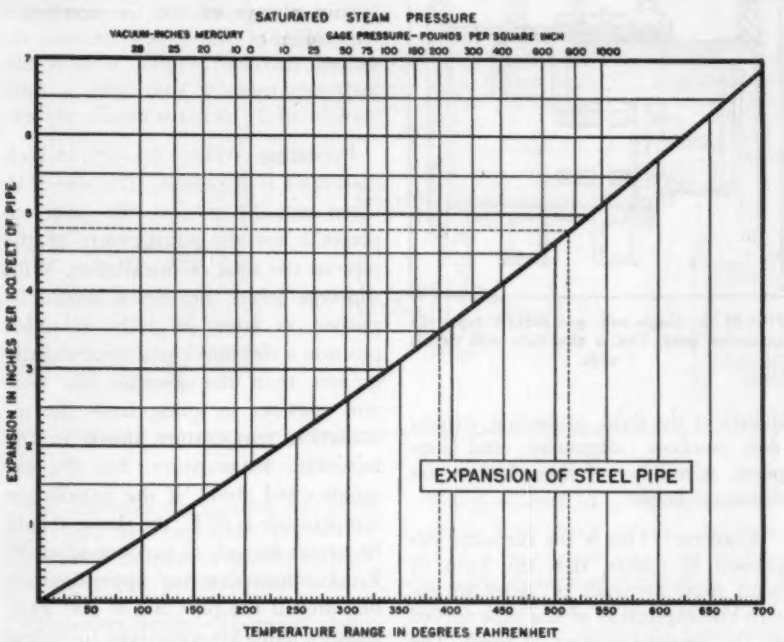

SATURATED STEAM PRESSURE
VACUUM-INCHES MERCURY
GAGE PRESSURE-POUNDS PER SQUARE INCH
28 25 20 10 0 10 25 50 75 100 150 200 300 400 600 800 1000
EXPANSION IN INCHES PER 100 FEET OF PIPE
EXPANSION OF STEEL PIPE
50 100 150 200 250 300 350 400 450 500 550 600 650 700
TEMPERATURE RANGE IN DEGREES FAHRENHEIT

FIGURE 7—Chart for quickly determining linear expansion of steel pipe for various steam pressures and temperatures.

ture range and pipe length involved, the total traverse and amount of presetting can be readily determined. It should be noted that when the minimum temperature is below 0 F., the temperature range used in determining expansion must be increased accordingly. Values taken from the curve include a safety factor of 10 percent over the actual pipe expansion to provide for discrepancies in installation and unforeseen temperature extremes.

Anchors—Anchors are important in any piping system, but there are some special considerations necessary when expansion joints or bends are used. In general, anchors are installed to stabilize the piping at certain vital points, such as valves or other equipment, junctions of two or more pipes, and terminal points. With expansion joints, anchors also serve to divide the system into sections, so that each joint absorbs only the expansion in its own section. This may seem elementary, but it is frequently overlooked. There are numerous instances where two joints are installed in the same section without intermediate anchors with the result that one joint becomes overloaded and subject to damage while the other one is underloaded. The converse of this is that two anchors should never be placed in a straight run of pipe without an expansion joint or other device to absorb the expansion between them.

Anchor design is particularly important with high pressures and large pipe sizes because of the high thrusts that develop at end anchors. End anchors are so called because they occur at terminal points and at changes in direction of the pipe. At these points, the pressure acting on the inside area of the pipe would tend, if unrestrained by anchors, to pull an expansion joint apart. Thus, end anchors must absorb this pressure reaction as well as the forces required to activate the expansion joint and to overcome friction in supports and guides. Intermediate anchors, on the other hand, are subject to only the latter forces. The curves in Figure 8 illustrate the comparative magnitude of end and intermediate anchor loads for slip-type expansion joints, and they also provide reasonably accurate anchor load figures for various pipe sizes and pressures. Values for corrugated joints are comparable, except that end anchor loads are somewhat higher in the larger pipe sizes because of the larger area in the bellows. Intermediate anchor loads are somewhat lower because bellows require less force to actuate them than do slip joints.

Occasionally installations have been observed where an expansion joint was anchored by only one of its two legs or by an inadequate number of anchor bolts. While this can be done safely under certain favorable conditions, it is not generally recommended. Such procedures have resulted in damage to the expansion joint or to the piping, either from the excessive loading on the secured leg or from the inadequate number of anchor bolts. Trouble of this sort is not the fault of the joint, but of the manner of installation. As a rule an expansion joint, like any other fitting, should be anchored with the full number of bolts provided for in the base.

Bending moments caused by offsets in the piping are another source of trouble. Offsets are often necessary to get around obstacles in the line of the pipe, or to shift its axis a few feet up or down or sideways. The net effect is to create a bending moment on the pipe and elbows that is proportional to the thrusts at the elbows and to the length of the offset. If the expansion in the offset leg is relatively small, an additional expansion joint may not be required, and diagonal bracing of the elbows to provide rigidity may suffice. However, every project must be checked carefully because frequently it is necessary to anchor both elbows to prevent excessive bending stresses in the pipe.

The importance of analyzing and properly providing for anchor loads is graphically illustrated in the following actual case. A large steam line in a tunnel had a right-angle offset of several feet. One elbow was connected to the body of a slip-type expansion joint which was very solidly anchored. The other elbow was lightly braced by an I-beam that was not properly aligned with the run of the pipe. This brace was not strong enough and it eventually collapsed. The full end-anchor load then acted on the offset and created a large moment at the other elbow and the expansion joint adjacent to it.

Although the joint anchorage was more than adequate for its normal loading, it could not support this additional stress. The anchor bolts were all sheared or dislodged from their concrete foundations; and, but for its limit stops, the expansion joint probably would have separated. Because of its rugged construction, it withstood

the abnormally high stresses imposed upon it and prevented further damage to the system. This case demonstrates the potential force of a moment; and, even more important, it shows how serious the effects of a failure in one part of the system can be to other parts of the system.

Pipe Alignment—Except for some specialized applications of the corrugated type, expansion joints and bends require good pipe alignment to perform satisfactorily. Guides serve two important purposes. First, when installed near an expansion joint they prevent cocking of the sleeve in a slip-type joint, or distortion and possible buckling of a corrugated-type joint, or an expansion bend.

Second, guides are usually necessary in long spans to prevent the pipe from buckling as the pipe expands. The tendency to buckle increases as the pipe becomes smaller in diameter, longer, or both; hence, the need for guides is greatest with long spans of relatively small pipe. Table 1 gives recommended spacing of guides from expansion joints and also between guides for various pipe sizes.

Pipe Supports—Table 1 also provides generally recommended spacing of supports for steel pipe filled with water. The importance of adequate support is well recognized. However, it should be pointed out that supports must be designed to withstand the thrust resulting from motion of the pipe over the supports as well as the vertical load due to gravity. Failure to provide for this thrust has resulted in failure of the supports in some installations.

System Design—Figure 9 shows a typical refinery piping system using slip joints, consisting of 8 inch steel pipe with a total length of 770 feet. It carries steam at 125 psig, with 25 F. superheat. The procedure for finding traverses, anchor loads, and guide and support locations is as follows:

TRAVERSES: Saturation temperature for 125 psig. steam is 355 F.

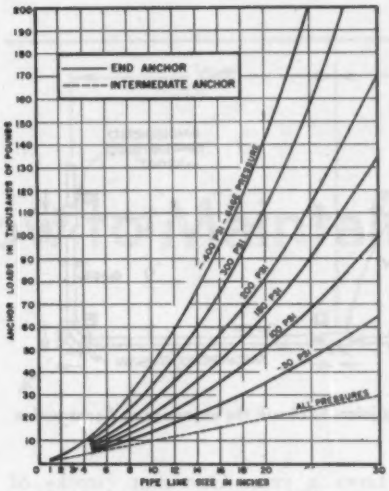


FIGURE 8—Anchor loads in intermediate and end anchors used with slip and other types of expansion joints.

(Figure 7). Add 25 F. for a total temperature range (assuming minimum temperature to be 0 F.) of 380 F. Expansion for this range is 3.4 inches per 100 feet, from Figure 7.

Span AB = 140 feet; expansion = (140) (3.4)/100=4.8 inches. A single-end joint with an 8-inch traverse is suitable at Point A. Span BC is 90 feet long and has an expansion of 3.1 inches when figured as above. Hence, the joint C is single-end with 4-inch traverse. The span CE is 430 feet long with 14.7 inches of expansion. A double-end joint with an 8 inch traverse at each end is suitable at D, the approximate mid-point. Span EF is 110 feet long with 3.7 inches of expansion, for which a single-end 4 inch traverse joint will be adequate.

ANCHOR LOADS: Intermediate anchors at A, D, and F are subject to possible maximum loads of 8000 pounds in both directions. These values are obtained from Figure 8 for 8-inch pipe. The contraction loads equal the expansion loads but are in the opposite direction.

End anchors at B, C, and E have possible maximum axial loads of 15,000 pounds in each leg (solid arrows, Figure 9). The resultant anchor load is the vector sum of the thrusts in the two legs, or 21,000 pounds acting along an axis 45 degrees from the pipe axes (dotted arrows, Figure 9). Maximum, contraction loads in the reverse direction consist of friction only and amount to 8000 pounds along the solid arrows with an 11,300 pound resultant.

Note: Anchor loads with corrugated joints will be somewhat higher or lower depending on pipe size, pressure, etc. Consult manufacturer's instructions.

SUPPORTS AND GUIDES: From Table 1, assuming the joints are the internally-externally guided type, install alignment guides not more than 18 feet from slip end of each joint and at intervals of 45 feet, more or less, along each span. Also, from Table 1, the pipe should be supported at intervals of about 18 feet and wherever concentrated loading exists due to valves and fittings.

Installation—Having designed the system and selected the expansion joints, it is advisable to observe the following points at the time of installation. Align the expansion joint carefully with the pipe span so that motion of the sleeve (or bellows) is axial and lateral thrust on the joints is minimized. Also, for the same purposes, be sure that guides adjacent to the joint are properly located and aligned. When installing expansion joints with anchor bases, use the full number of bolts provided for and tighten the nuts securely. This is particularly important at end anchors.

If the temperature of the pipe at the time of installation is appreciably higher than the minimum temperature designed for, expansion joints should be preset to allow for contraction. To do this, the sleeve of a slip-joint should be pushed in from its fully extended position a distance at least equal to the distance the pipe will contract in going from installation temperature down to minimum temperature. Corrugated joints are sometimes furnished in mid-position to cover such conditions, but with all designs of joints and bends the manufacturers' instruction should be carefully followed.

Initial Operation—When the system is first energized, expansion joints should be checked for leakage or any other signs of improper operation. Usually joints which are properly

TABLE 1
Recommended Spacing for Pipe Alignment Guides and Supports, in Feet

Nominal Pipe Size, Inches	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
Distance between guide and expansion joint																
For internally guided joints	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12
For internally-externally guided joints	8	10	11	12	13	14	15	16	18	20	21	22	23	24	25	26
Distance between alignment guides	10	13	15	19	22	25	30	35	45	60	70	80	90	100	105	110
Maximum distance between pipe supports	8	10	11	12	13	14	15	16	18	20	21	22	23	24	25	26

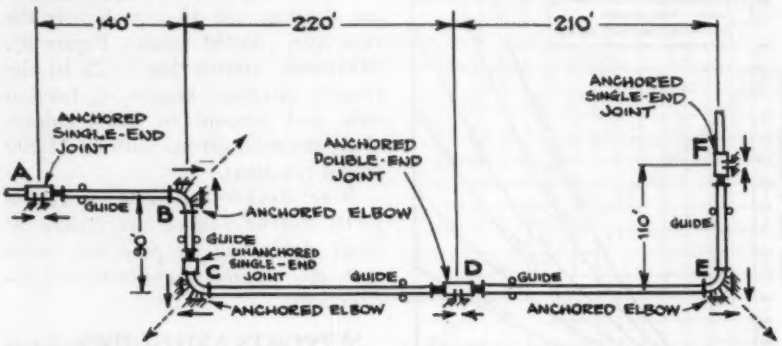


FIGURE 9—Typical refinery piping system using slip joints to absorb the expansion and contraction.

constructed and installed will need no attention for the first few weeks. However, it is quite normal for the packing to require some attention after a month or so in service. In a conventional gland-packed joint this consists of tightening the gland nuts evenly until signs of leakage disappear.

In the gun-packed type, the addition of only a few plugs of plastic packing (depending on size of joint) is necessary. Once this initial adjustment period has passed a regular maintenance schedule should be established, the frequency of which will depend on the operating conditions (steam pressure and temperature) and the type of joint used.

Lubrication—Good maintenance of expansion joints is primarily a matter of keeping the packing tight to prevent leakage and lubricated to keep sleeve friction low. Though not recommended, most joints will operate in a dry, unlubricated condition, but the stresses in the pipe, fittings, and anchors will be considerably reduced by a nominal amount of the correct lubricant. Furthermore, lubrication helps retain the sealing qualities of the packing, in the conventional as well as the gun-packed type.

In the better designs, alemite-type fittings are provided on the body of the expansion joint, through which lubricant can be added to the stuffing box with a lever-operated gun. Fittings are usually the hydraulic or button-head type and have built-in check valves to prevent blow back from the pressure in the stuffing-box.

In the average case, gun-packed joints on continuous service need lubrication no more than two or three times a year. One shot (stroke of pump-gun lever) in each fitting will usually suffice to maintain optimum packing quality. Only in rare cases of relatively high pressure and temperature should it be necessary to increase this rate. Excessive lubrication is shown by oil being extruded between the sleeve and gland. Always use the lubricant recommended by the manufacturer of the joint.

Packing—Packing requirements of conventionally packed expansion joints will vary according to a variety of factors such as service pressure, and temperature, traverse, frequency of expansions and contractions, design of joint, and alignment of installation.

Conventionally packed joints are kept tight by taking up on the gland nuts from time to time. Eventually, of course, steam must be shut off and the stuffing box overhauled; i.e., the gland pulled back, old packing removed, and fresh packing installed. Packing rings should be carefully measured and cut to fit the stuffing box snugly. Rings should be installed with ends staggered so as to minimize the possibility of leakage from one ring to the next. It is most important that the gland be tightened evenly so that cocking is eliminated (no binding on the sleeve) and packing pressure is uniform around the sleeve circumference.

The great advantage of the gun-packed expansion joint is that it does not require overhauling. The cost and inconvenience of shutting down the system is completely eliminated. Leaks are sealed simply by forcing small plugs of a specially prepared plastic packing into the stuffing box by turning a threaded plunger with a short wrench. This feature is shown in Figure 6.

In normal service, packing needs to be inserted in gun-packed joints only two to four times a year. Experience varies considerably, depending on service conditions, and some installations have required no more than one packing addition per year. The amount of packing inserted varies from one or two plugs to several plugs per packing gun, the number of guns per joint varying from one to 12, depending on the size of the joint. As a rule it is wise to establish a regular schedule of packing and lubrication maintenance, the nature and frequency of which can best be determined by experience in the particular installation.

Refinery and petrochemical piping systems provide many opportunities for wise use of all the available means to absorb pipe expansion. The ultimate choice of the method to be used lies with the designer of the piping system. The pointers outlined in this article should be useful to all designers, operators, and supervisors who must choose, use and maintain devices for absorbing pipe line expansions and contractions. # #

Meet the Author

K. S. ROBERTS received his B.S. degree in engineering from Hartford College, Hartford, Pa. in 1942. His professional experience includes being a field engineer with the U. S. Coast and Geodetic Survey, Washington D. C. from 1947 to 1948; and a cost engineer with General-Shea-Morrison, Inc., contractors for the Hungry Horse Dam in Montana from 1948-49. Roberts is presently a mechanical engineer for Yarnall-Waring Co., Philadelphia, Pa., where his duties include the design and application of expansion joints and other products.

How to Maintain Steam Traps

Check these trouble spots and ways to improve the operation of traps in your plant.

Leo Walter
Gloucester, England

STEAM TRAP maintenance boils down to avoiding two main troubles: (a) condensate is not being discharged at desirable capacity, and (b) live steam escapes into the condensate return piping system or into atmosphere. Because both troubles can be interlinked, a diagnosis is not always easy.

Failure in System—System defects which can hamper discharge capacity can be deposition of solid matter inside and/or outside of heating coils. These coatings affect heat transmission values and reduce condensate rate, thus prolonging heating time. Undetected leakages from heating pipes can have the same effect, and so can a widely fluctuating steam supply pressure. So the first point is to see whether condensate really forms in desired quantities. The remedy afterwards is to put the plant right so that the steam trap can do its job. Another cause of reduced condensate is the presence of air or gases, which can be cured by using automatic air vents. Back pressure in return mains can also hamper discharge, and so can the overloading of return lines. Too violet flash steam formation in a common return line can cause excessive back pressure; and as steam trap capacity depends on the pressure differential between inlet and outlet of the trap body (and also on the area of the valve seat within the trap), this return pressure must be carefully watched. The remedy is to eliminate back pressure formation in condensate return pipes as far as possible, and sometimes to fit traps with increased discharge capacity to any equipment which shows signs of water-logging.

Another trouble can be back-syphoning, i.e., where water is drawn back into the system from some outside source. A most serious trouble can be water-hammer as the result of back-syphonage caused by live steam in piping coming into contact with a bulk of accumulated water and setting up a high velocity wave motion. To avoid destructive results, the cause of water-hammer should be removed; but at least bucket traps should be fitted which stand up better to such conditions than bellows or float types. The use of vacuum-breakers or of check valves may also cure the trouble; and elimination of sagging pipes or at least fitting of drip traps at lowest points should be performed.

Sometimes close examination of check valves might disclose that they stick; or pipe line strainers in front of the trap have become choked and set up back pressure. Checking of these auxiliaries should precede the opening of the trap itself and may be responsible for low capacity of condensate discharge.

When inspection of the system fails to reveal the cause of failure, it can be assumed that the trap itself is at fault and not a system defect present. Every year millions of steam traps are replaced because they have failed in some way. To avoid the causes for replacements can save a great amount of expenditure. In servicing and maintenance of steam traps, look for these danger spots:

Steam Trap Design—Obviously proper care and maintenance requires a good knowledge of the inner working parts of all types of steam traps used in a factory and how they function. Three main parts have to be considered: (a) trap body, (b) disc and seat, and (c) mechanism used for condensate discharge.

(a) **Trap Body**—When installing a trap or when dismantling it, avoid distorting the body casting. True, it is seldom that any harm comes to them, but sometimes rough handling is responsible for trap failure. This applies especially to thermostatic traps having screwed caps.

(b) **Disc and Seat**—Inspect disc and seat regularly. It will be wise to regrind the seat and disc periodically. The use of a pipe line

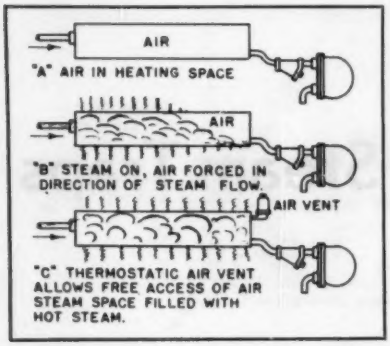

AIR
"A" AIR IN HEATING SPACE
AIR
"B" STEAM ON, AIR FORCED IN DIRECTION OF STEAM FLOW.
AIR VENT
"C" THERMOSTATIC AIR VENT ALLOWS FREE ACCESS OF AIR STEAM SPACE FILLED WITH HOT STEAM.

FIGURE 1—Use of air vent prevents air lock.

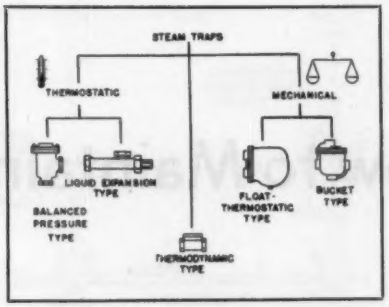


FIGURE 2—These are the common steam trap types. Each one has its application and limitations.

strainer in front of a steam trap is just as essential as the fitting of a sight glass or tell-tale after the trap to discover at a glance if the trap blows steam.

(c) **Mechanism**—In a thermostatic trap the temperature sensitive element is either a bellows filled with a volatile liquid or a bi-metal element. Bellows elements should last a long time; but corrosive condensate, water hammer or overstrain and sometimes faulty material of the bellows or faulty soldering might cause it to become prematurely "dead." Avoid overstrain on bellows elements and keep a spare element handy.

Correct Installation of Steam Trap Types—In float-operated traps the closed ball float is a vulnerable part because any puncture will render it inactive. Periodical examination will show where a protective coating has been worn off so that it can be repaired. Deformation from water hammer should only be tolerated in a very moderate way, and badly deformed floats replaced at the first opportunity. Stainless steel or monel floats withstand corrosion better than brass or copper.

Bucket traps are less sensitive to water hammer, but attention should be given to the lever mechanism to keep it clean and moving freely. Dirt, rust and mis-alignment might cause sticking of moving parts. Excessive play should also be attended to as it also will cause faulty action.

The main consideration when fitting a steam trap and its auxiliaries should always be to make servicing easy. A trap must be easily accessible and should be fitted away from dirt and dust. A trap will work without auxiliaries but for economy and convenience it should have, in front, a pipe line strainer, and after the trap a sight glass or flow indicator, and where necessary a check valve. Isolating valves, test cocks, etc., depend on circumstances.

Hints for Trouble-Shooting—If a steam trap should fail and the reason be not obvious, the following hints might perhaps come in useful. First the working differential pressure should be checked. It may be that lift of condensate is too high, or that back pressure has developed due to choking of the condensate pipe or sticking of the check valve, or that due to low steam pressure the valve lift has stopped and the trap becomes waterlogged.

Where steam pressure at the trap is too high for the design, the trap should be changed. Where too low, either a larger size of trap has to be fitted; or if an obstruction in front of the trap causes this low pressure (such as too small a diameter of condensate pipe), this has to be remedied. Maintenance fitters should be familiar with capacity tables from the maker; and where a trap is too small for the job it should be exchanged for the next larger one. The snag, however, is that all capacity tables have to be used with a capacity factor, which can be 2, 3, or more depending on working conditions (such as condensate volume, pressure differential. This involves guesswork.

It is not intended here to deal with correct selection of the type of steam trap for a job, but after service men have made themselves familiar with this "science" of choice they will be able to exchange any unsuitable type. For example, themostatic traps of the bellows type are sensitive against external heat. Ball float traps are sensitive against internal heat (superheat). Bucket traps have to be kept in strict vertical position.

Regular Inspection—Where inspection shows that the mechanism is worn, damaged or clogged, or where a float has become water-filled or has collapsed, either external conditions or materials used can be responsible. As mentioned before, wrong materials or excessive corrosion is the cause of many failures. This can sometimes be stopped by detection of leaking heating coils or other cause of contamination of the condensate. Loose parts within a trap usually indicate poor workmanship or wrong assembly methods. Sometimes a trap may be poorly adjusted and can easily be repaired.

The greatest enemy of correct trap function is dirt, scale or other foreign matter in the piping system, and the service engineer is wise to look out for these first. Freezing of traps can be avoided by draining them and by using a suitable thermostatic type trap.

Where the condensate does not reach the trap at all, either a throttled stop valve in the condensate return, or an air lock might prevent free flow. By using a steam-lock release type of trap, or by fitting an equalizing pipe such troubles can be cured. An open by-pass incorporated in a trap, or externally provided is a source of great steam waste and should not be tolerated. A good trap design, correctly sized and fitted with air vent should not need a by-pass at all for heating up purposes (Figure 1).

The conclusion to be taken from this brief survey should be the following. Include steam traps in the general preventive maintenance scheme.

- Work out a definite plan for a rota-system for steam trap inspection throughout the refinery.
- Keep records on all troubles discovered; and where service becomes too frequent and costly, change to another type of trap. ##

MAINTENANCE

Centrifugal Pump Packings and Seals

Handbook

Part 1—Packing Boxes and Glands
Part 2—Packings
Part 3—Mechanical Seals
Part 4—Mechanical Seal Maintenance
Part 5—Packing Maintenance

Construction features, installation and maintenance of all types of packings, glands and seals are discussed in this series.

Harold Woodhouse
Dean Hill Pump Company
Indianapolis

A LARGE REFINERY is an impressive spectacle and a giant conglomeration of many of the twentieth century's latest industrial developments. But, like all giants it has its vulnerable spots. One such spot has been the insignificant little item of shaft packing for centrifugal pumps. For instance, the effect of using one kind of packing, aluminum metal foil for light hydrocarbons service was attributed by one refinery as causing an explosive fire.

The packing and packing boxes of a centrifugal pump seem to be simple elements yet they account for more down time than any other part of the pump. Glands are improperly tightened, packing boxes are not correctly filled, or the wrong packing is used.

This article deals with packing boxes and glands, their use and maintenance.

Figure 1 shows a typical packing box having an integrally machined throat. The throat acts as a backstop for the packing and limits the leakage of liquid in the event of complete packing failure. The clearance between the throat bore and the rotor is a variable according to size of pump but 1/32 inch might be taken as an average figure. The clearance between the gland and the rotor is shown as 0.025 inches which, again, might be taken as an average figure.

Since the gland is not machined to a close fit in the packing box bore, it can be seen that the tightening of one gland bolt will probably cause the gland to "cock" and rub on the sleeve or shaft.

Figure 2 shows a packing box having a separate throat bushing. The use of a separate piece for the throat bushing permits easy replacement if it becomes badly worn. It can be made fairly long to reduce the amount of liquid leakage which may take place if the packing should fail completely.

The throat bushing is generally made with a tongue to fit a groove, both of which, in horizontally split casing pumps, extend only around the lower half to prevent the throat bushing from turning.

Figure 3 shows the standard type of two piece interlocking design, which is not bolted together and, therefore, can be removed from the shaft with maximum facility. Its function is to hold the packing in the packing box under the correct amount of compression to produce the seal required.

Figure 4 shows a "smothering gland" which is used when the pump is handling liquids where leakage from the gland could result in the release of inflammable gas, noxious fumes or vapors.

The smothering gland has an inside annular space surrounding the

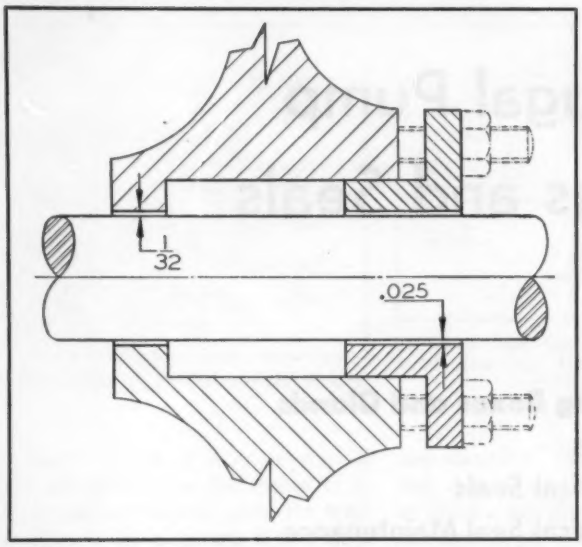


FIGURE 1—Typical packing box has integrally machined throat.

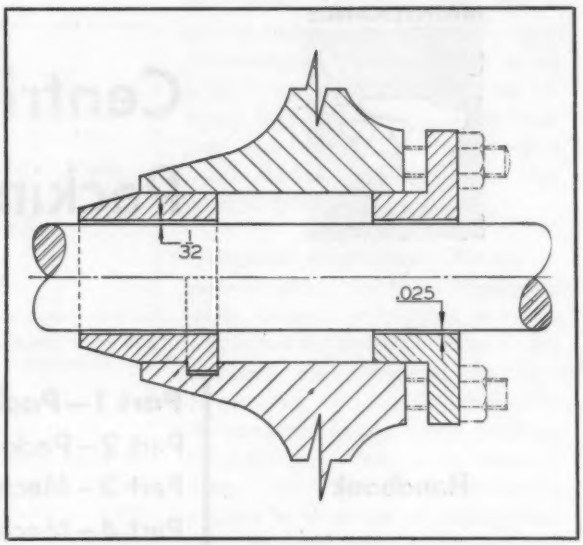


FIGURE 2—Packing box with separate throat bushing.

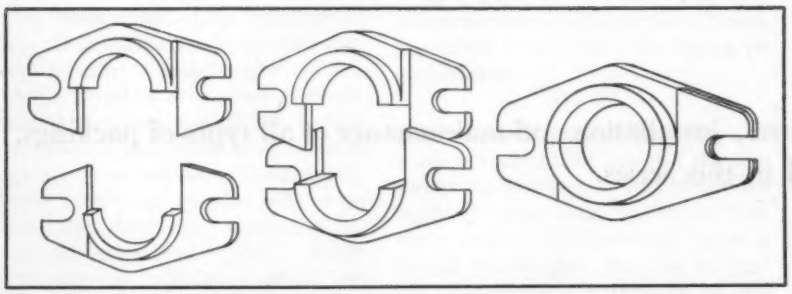


FIGURE 3—Two piece interlocking type gland can be easily removed from the shaft.

rotor to which flexible water supply and drain lines may be connected for flushing away the leakage. Flexibility of the water lines is necessary to permit adjustment of the gland for maintaining correct packing compression. The smothering, or quenching, liquid also serves to form a heat stop on the shaft of hot pumps; it dilutes harmful liquids and absorbs harmful vapors resulting from the leakage of volatile liquids.

Figure 5 shows a smothering gland with auxiliary packing to prevent loss of the quenching liquid along the shaft. The quenching liquid is fed directly to the packing box from a separate, independent source.

Figure 6—In refineries, many pumps are handling inflammable liquids. For this reason it is dangerous to allow a gland, of steel, cast iron or other sparking type material, to rub on a shaft or sleeve made of a sparking type material, since it may ignite or explode the leaking vapors. Therefore spark-proof glands must be used. They are made from either solid bronze or brass, or they have spark-proof bronze or brass bushings inserted as shown.

Bushed type glands are also used to combat the corrosive action of acid pumps. The acid can cause rapid deterioration of the inside of the gland, which would necessitate complete replacement of the gland if it were not bushed.

Figure 7—If a pump is handling clear, cool, water (under 180 F.), or other clear liquid with some lubricating qualities and the suction pressure

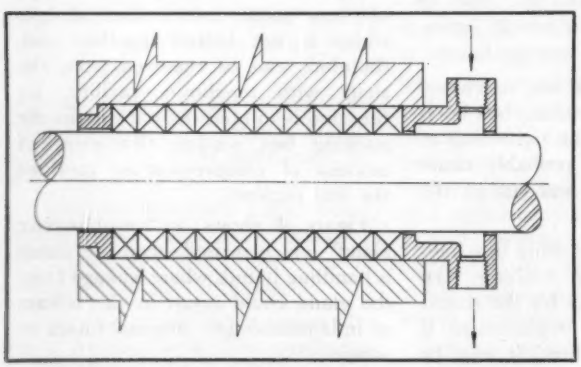


FIGURE 4—"Smothering gland" prevents leakage of inflammable gas, or noxious fumes.

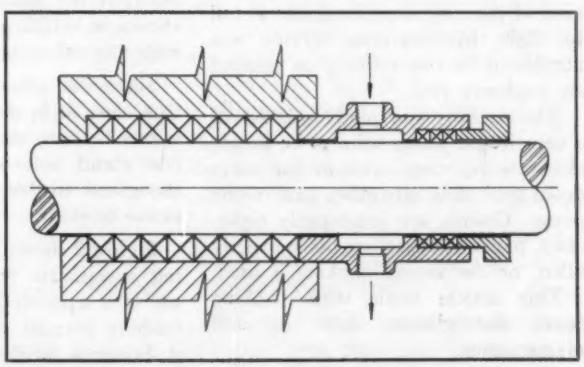


FIGURE 5—"Smothering gland" with auxiliary packing prevents loss of quenching liquid along the shaft.

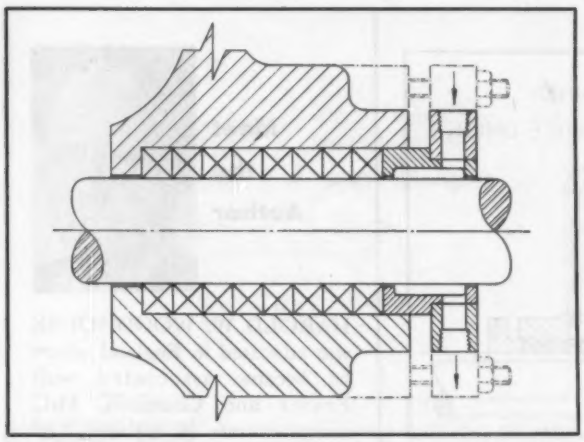


FIGURE 6—Spark-proof bronze or brass bushings prevent explosions.

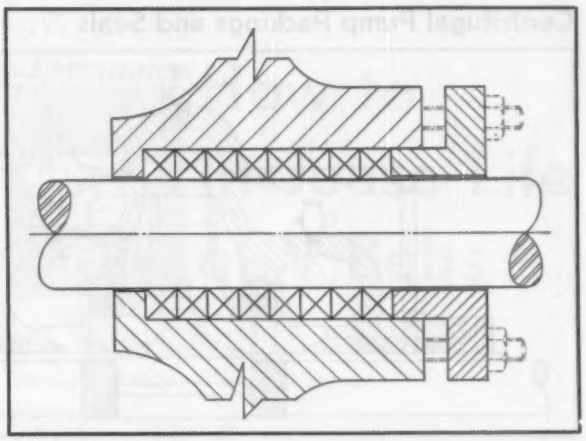


FIGURE 7—Clear liquids allow packing box to be filled solidly with packing.

is above atmospheric, but moderate, then the packing boxes may be filled solidly with packing as shown. It is essential that the packing be loose enough at all times to allow a slight liquid leakage to keep the packing cool and provide a lubricating film around the shaft. Many shaft rotors are damaged at initial starting because an inexperienced operator will have the glands too tight or, if he sees a leakage, he tightens the gland until it stops.

Figure 8—Where there is a suction lift on a pump handling clear water or other clear non-corrosive and relatively inert liquid at a temperature well below its flash point, a lantern (or injection) ring is added to the approximate center of the packing box with a connection to it from the pump discharge volute as shown. This is known as an internal seal. An internal seal has only the one liquid connection on the packing box and for this reason is referred to as "dead-ended." It is also called an "injection box" and the sealing liquid is called "injection liquid."

Figure 9—If the liquid temperature is sufficiently high as to approach the flash point then the packing box may be separately cooled as shown.

Figure 10—Where the gritty content in the pumped liquid is small, an internal seal is sometimes used with a strainer in the line. To limit the leakage with an internal seal in the event of gland failure, an orifice may be put in the seal line as shown, but this is more usually done with mechanical seals.

Figure 11—When it is necessary to seal a packing box with a liquid other than that which is being pumped so that the sealing liquid is supplied from a separate source, then it is referred to as an "external seal."

External seals are required if pumping water over 180 F., for volatile, toxic, corrosive or acid liquids, for gritty liquids and slurries. The sealing liquid, also referred to as the quenching or injection liquid, or gland oil, is brought to the packing box, fed into the box at the lantern ring and is piped away on the opposite side or allowed to drain into a drip-rim baseplate. The latter method is commonly done if the liquid is hot water.

This method is also referred to as a "circulating system." The packing box may, or may not, be water cooled.

The compatibility of the sealing liquid used with external seals must be considered in relation to the pumped liquid as some contamination is bound to occur.

Normally, the sealing liquid pressure is maintained about 10 psig above that at the packing box. A steady pressure is desirable as a variable pressure will cause some flexing of the packing and accelerate its wear. Sometimes sealing liquid pressure below pump suction pressure is used where there is a high suction pressure and where leakage of the pumped liquid into the sealing liquid is not objectionable.

When pumping certain non-lubricating type hydrocarbons, solvents and other liquids, a grease lubricator using a non-solvent grease may be tapped into the packing box.

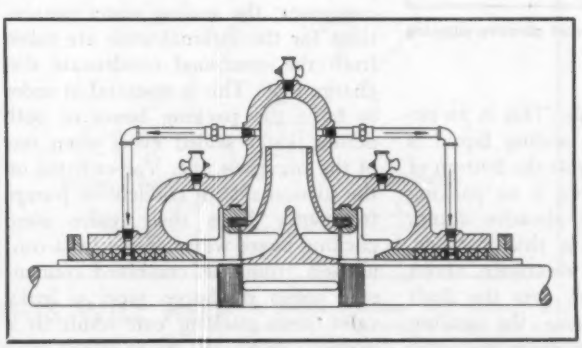


FIGURE 8—Internal seal has a "lantern ring" in center of packing.

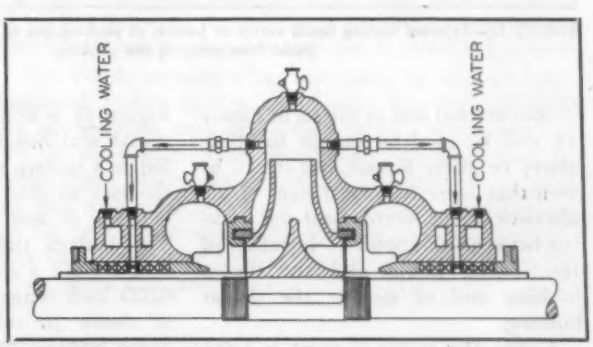


FIGURE 9—Cooling water is added if liquid temperature approaches the flash point.

Centrifugal Pump Packings and Seals . . .

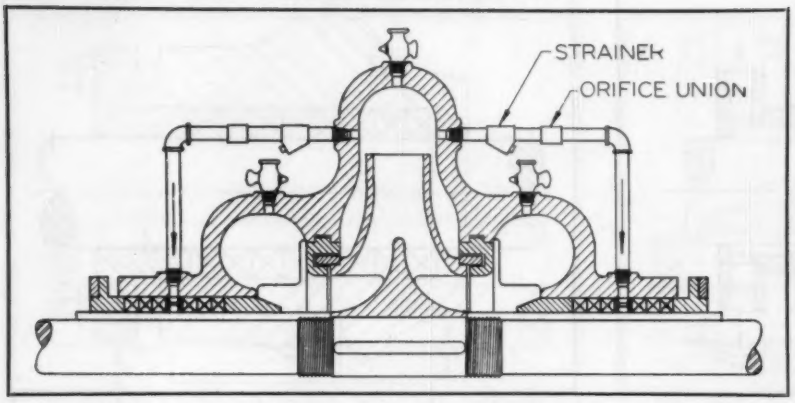


FIGURE 10—If pumped liquid is gritty, an internal seal is used with a strainer in the line.

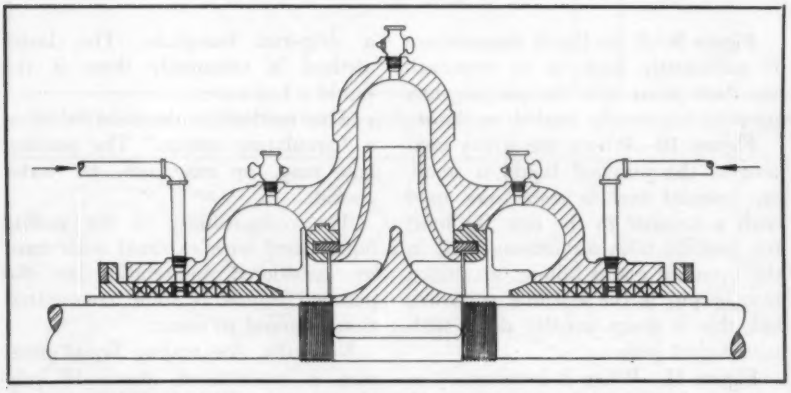


FIGURE 11—External seal uses liquid other than that being pumped.

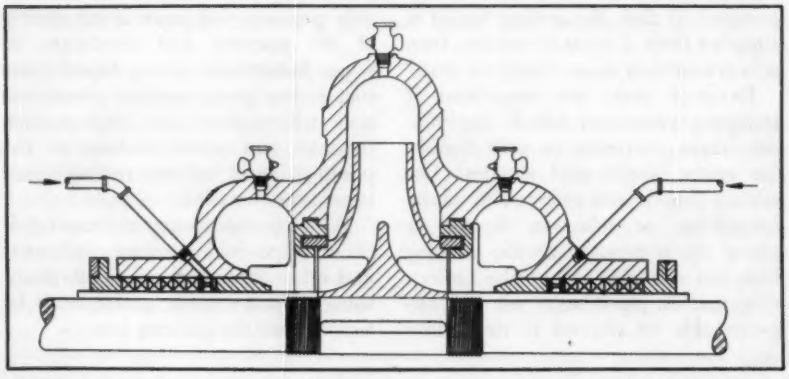


FIGURE 12—External sealing liquid enters at bottom of packing box to prevent abrasive pumping liquid from entering the packing.

An external seal as shown in Figure 11 may be used on pumps handling slurry or gritty liquids, but it can be seen that there is some danger of the abrasive liquid wearing out the packing between the point of injection of the sealing liquid and the throat bushing and of scoring the throat bushing.

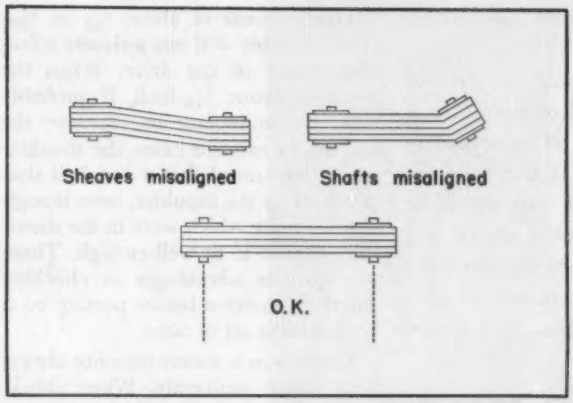
Unless the gritty element is quite slight an arrangement similar to Figure 12 is desirable. This is an external seal but the sealing liquid is fed to a lantern ring at the bottom of the box so that there is no packing between it and the abrasive liquid. The lantern ring, in this instance, should have a close clearance, about 0.025 inch diametral, over the shaft or sleeve to minimize the sealing liquid leakage. The packing box may, or may not, be furnished with an additional lantern ring as shown, depending on the temperature and type of liquid being handled by the pump —if furnished, it may be a "dead-ended" or "circulating" arrangement.

Where two or more condensate pumps are connected to the same condenser, the sealing water connections for the internal seals are taken from the combined condensate discharge pipe. This is essential in order to have the packing boxes of both pumps water sealed even when one of the pumps is idle. Valves fitted on the suction side of condensate pumps frequently have their valve stem packing boxes water sealed by a connection from the combined condensate pump discharge pipe as leaky valve stem packing can result in a material reduction in vacuum.

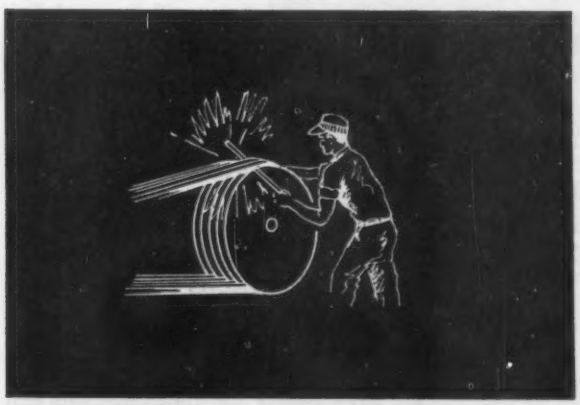
Part 2 will appear in the February REFINER.

Meet the Author

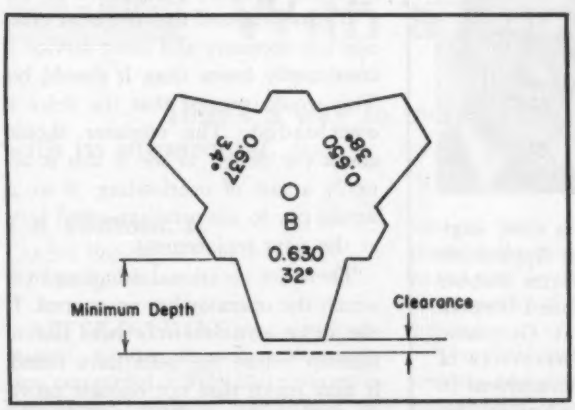
HAROLD W. WOODHOUSE was educated in England where he became associated with Fraser and Chambers, Ltd., manufacturers of turbines and compressors. When he came to this country, he became engineer in charge of radial flow turbine wheels and mixed flow compressor impellers for the De-Laval Steam Turbine Co. Then from 1945 to 1947 he was director of engineering for the Stratos division of Fairchild E & A Corp. After that he became general manager and chief engineer of Power Generators, Ltd., supervising design of high pressure and temperature turbines and centrifugal pumps for the U. S. Navy. For the past six years, he has been chief engineer for the Dean Hill Pump Co. Woodhouse is a member of the API Committee on Mechanical Drive Turbines, Centrifugal Compressors and Pump Manuals.



WATCH THIS Here are two common faults that contribute to short life and poor service from V-belt drives. Make certain that the sheaves are lined up properly and that shafts are reasonably parallel. Of these two suggestions, keeping shafts parallel is more important.



DON'T DO THIS Never pry belts over a sheave. Instead, loosen the take-up. V-belts are elastic but they are not rubber bands. Forcing a belt over the groove can break the tensile cords in the belt making it impossible for belt to carry its share of the load.



THIS WILL HELP A simple template well marked will enable the operator to check the wear on the sheaves quickly and accurately. Wear is observed by seating template squarely in the groove and sighting between the sides of the template and sides of groove.

MAINTENANCE

How to Increase Life of V-Belts

W. S. Worley
The Gates Rubber Company, Denver

MORE AND MORE V-belt drives are being used to transmit power from prime movers to pumps. Characteristically, a V-belt drive requires surprisingly little care and maintenance. An understanding of the fundamentals of how a V-belt operates in the sheave groove, and a knowledge of the stresses to which its various components are subjected while transmitting power, enables an operator to: (1) Identify and correct the troubles which infrequently arise, and (2) realize long, trouble-free service for which the drive was designed.

SETTING UP THE DRIVE

Use a matched set of belts of the same manufacture. Of primary importance to optimum performance and long belt life is use of a matched set of belts of the same manufacture. Do not try to make up a set of belts of different manufacture or of some new and some old belts. A new belt, when placed on a drive with old belts that are worn, may take more than its share of the load. It will be shorter and probably will ride higher in the grooves.

If belts of different manufacture are used, there is a good chance that pitch line locations will not be the same for each belt. Differential driving will result. Possibly the strain constants of the belts may be different. This will result in different amounts of creep and, again, in differential driving.

Clean the sheaves. Clean oil and grease from the sheaves. Remove rust and burrs. Since the belts operate by friction, anything which tends to reduce the coefficient of friction between the belts and the sheaves can mean that higher belt tension are required to handle the load.

The V-belt wedging effect multiplies the normal force produced by belt tension to the point that belt dressings are not required on V-belt drives. In fact, such dressings can do more harm than good. Some dressings tend to break down the rubber in the V-belts, and also to pick up dirt and sand to which pump drives are exposed. As the belt moves with respect to the sheaves, the sand acts as an excellent lapping compound which quickly wears down the groove sidewalls.

Align the drive. Make sure that the sheaves are lined up properly and that shafts are reasonably parallel. Of

these two suggestions, keeping the shafts reasonably parallel is the more important. When shafts are not parallel, the belts will be progressively tighter toward one side of the drive.

This does not mean that it is necessary to use a transit to set up V-belt drives. An ordinary steel tape, intelligently used, can insure that the shafts are reasonably parallel. The sheaves can be aligned simply by sighting along the edge of one sheave to the other, or by stretching a string from the edge of one sheave to the edge of the other.

Install the belts. When installing V-belts, slack off on the take-up so that the belts can be put on without forcing. Although V-belts are elastic, they are not rubber bands. Forcing a belt over the groove can result in breaking the tensile cords in the belt. The belt will then be unable to carry its share of the load, forcing other belts in the set to carry more than their share.

Take up the slack until only a slight bow appears in the slack side of the belts when operating. If the belts slip, tighten them slightly. If they appear mismatched, but have the right range of matching numbers, tighten a little more, and let the drive operate for a while.

After the drive has been installed and has operated for a day or so to give the belts a chance to seat themselves properly in the grooves, retighten the drive and check alignment and parallelism of the shafts.

MAINTAINING THE DRIVE

Once the belts have been installed and the drive has been set up, only a minimum of maintenance will be required—and that maintenance will consist primarily of preventive inspections.

Inspect the drive occasionally. The operator occasionally will want to check to see that the drive is up to speed, that the belts are clean and free from oil and grease, are not rubbing against a belt guard or other obstruction, appear reasonably matched and are in good alignment. He will want to see that the shafts are parallel and are all operating properly. If malfunctions are noted, the operator will want to determine the trouble and correct it.

Pump speed should be checked against engine speed to determine if the drive is slipping. If so, a take-up should be made. If the belts are greasy and oil-soaked, they should be cleaned with a gasoline-soaked rag and steps taken to prevent this from recurring. If this can not be prevented, then oil-resistant belts should be installed.

Check sheave grooves before replacing a belt. After the first belt or so has failed, continue to operate the drive—retensioning the remaining belts if necessary—until a replacement set has been secured and it is convenient to shut the drive down and make the replacement. When a set of replacement belts is indicated a careful check of the sheave grooves should be made so that a new sheave can be ordered at the same time if necessary.

A template will prove very useful in checking the sheaves. In using such a template, the proper stub (which is shorter than the minimum depth) to fit the angle of the groove is found by experimenting. Wear is observed by seating the template squarely in the groove and sighting between the sides of the template and the sides of the groove.

Meet the Author

W. S. WORLEY is chief engineer of the Product Application division of The Gates Rubber Company. He attended Western State College at Gunnison, Colo., and the University of Colorado, where he majored in mathematics and physics. He joined The Gates Rubber Company in 1942 after spending six years in sales work.

Groove wear of about $\frac{1}{64}$ to $\frac{1}{32}$-inch probably will not seriously affect the service of the drive. When the wear is about $\frac{1}{16}$-inch, it probably will pay to replace or regroove the sheave. In extreme cases, the shoulder is so pronounced that a new belt simply rides on the shoulder, even though the old belts, which wore in the shoulder, seemed to fit well enough. There are obvious advantages in checking for this condition before putting on a replacement set of belts.

Grooves in a sheave may not always wear down uniformly. When checking for wear, it is good practice to check for uniformity of the grooves with a template. If the template does not fit each groove similarly within about $\frac{1}{64}$-inch at the apparent top width, there may be enough differential driving so that regrooving or replacing the sheave will pay good dividends in longer belt service.

No magic necessary. On occasions when inspection shows that a problem exists, common sense usually will suggest the right procedures. For example, a matched set of belts has been operating a few days and one belt seems to be longer than the others. The sheave grooves were checked and found satisfactory before the belts were installed, so possibility of differential driving can be ruled out. An inspection of the apparently long belt is made. Chances are that it was pried over the sheave in installing, and a spot where the belt has narrowed, or "necked down" will be found. This is the point at which the tensile section was damaged on installation.

It may be found that frequent take-ups are necessary and drive service is consistently lower than it should be. This would suggest that the drive is overloaded. The engineer should check the design to see if this is actually a case of overloading. If so, it would pay to use premium-rated belts at the next replacement.

There are occasional situations over which the operator has no control. If the drive consistently runs out of take-up before the belts have failed, it may mean that not enough provisions for take-up have been made. This, and similar problems, should be referred to the design engineer for review. ##

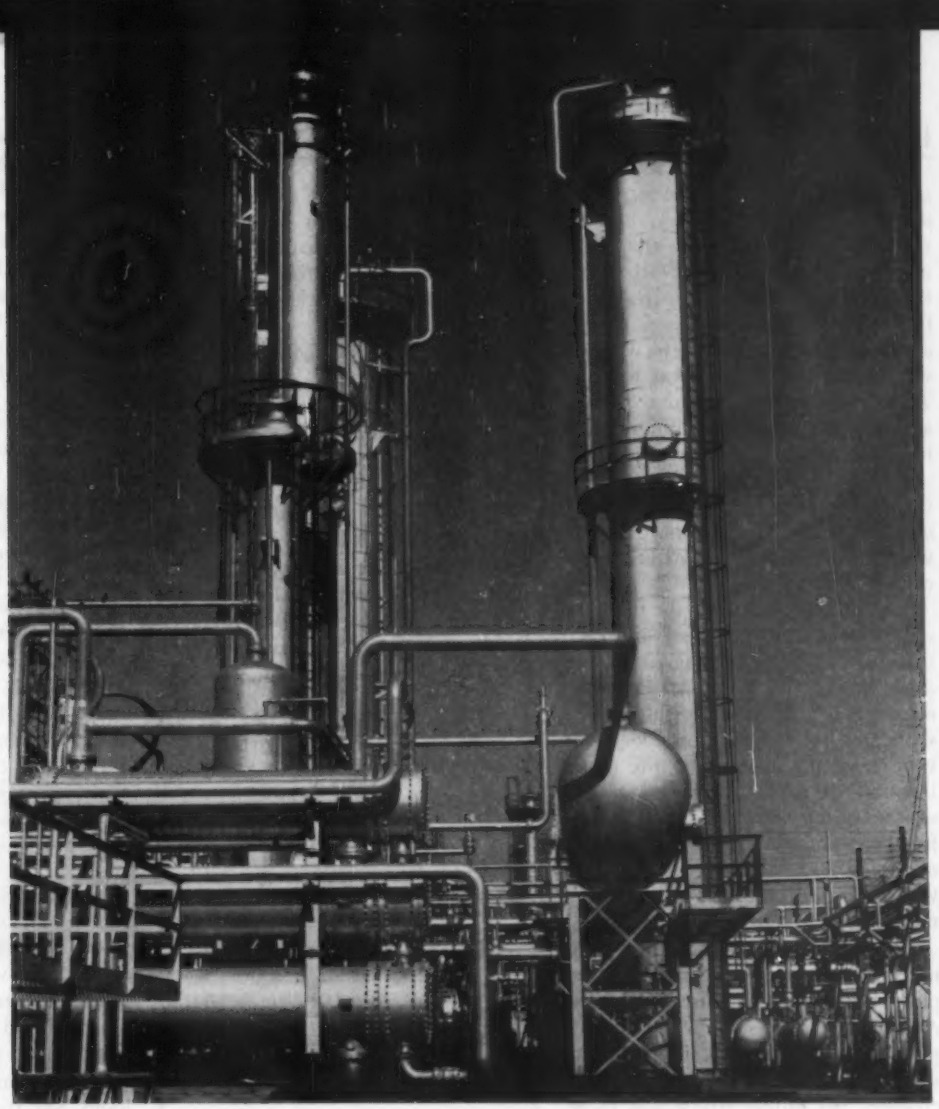


FIGURE 1—New debutanizer column on right was set, insulated and partially piped before the cat cracker came off stream.

MAINTENANCE

Integrate Your Major Revamps With a Turnaround

Here's a way to increase cat cracker capacity 50 percent in conjunction with its turnaround.

E. H. Boullioun, Jr.
Cosden Petroleum Corp.
Big Spring, Tex.

AFTER 965 DAYS continuous operation, Cosden Petroleum Corporation completed a $750,000 revamp in conjunction with a turnaround of their cat cracker in 35 days downtime and increased the coke burning capacity by 50 percent.

Advance planning and co-ordination of work were the keys which made it possible to complete maintenance and at the same time increase the capacity of the cat cracker by 50 percent.

The chief engineer made an engineering and drafting schedule. Work assignments were made to the five engineer-draftsmen who worked on the job. At the same time a field schedule was established for the work that was to be completed before the cat cracker was to come down. With the chief draftsman in the role of drafting and engineering co-ordinator, weekly meetings were held with the chief engineer. The work of the past week was reviewed and the priority was established for the work which was to be done during the following week.

One month before the cat cracker came down, the weekly meetings were enlarged to include all the engineering

staff and all the maintenance foremen. In turn the foremen outlined the jobs to be done with the craftsmen who were to do the work. When the cat cracker came off stream, the full benefits of the meetings became apparent. Each man knew what he was to do and how he was to do it. The work was carried out without any confusion and a minimum of interference.

When the cat cracker came down the engineers moved to the field to become project engineers over the work with which they had been concerned.

From the beginning of the planning stage one of the principal aims was to complete all work which could be done before the unit was taken off stream. To this end a special welding shop was set up using welders who were normally assigned to the maintenance department. The special welding shop handled only welding for the cat cracker revamp. Any piece of piping that could be prefabricated was completed and stacked in a designated area close to the job site.

All prefabricated piping was marked according to line size and piece number to facilitate assembly. A color coding system was also employed to the existing piping in the unit which was to be involved in any changes. All piping which was to be completely removed was noted by a yellow stripe. If only a portion of an existing line was to be removed, it carried a yellow stripe and the terminal points were noted with a green stripe. This system of color coding was also used on pumps and exchangers which had to be removed or relocated, thus preventing any time being wasted inspecting equipment which was to be removed from service.

Since the existing main air blower was already operating at maximum output, a second main air blower was installed in parallel. The second air blower with its piping over to the regenerator was in place before the cat was taken off stream. Only one field weld was required to tie in the new blower with the old blower.

Of the 39 foundations required for new equipment, 25 were poured prior to the turnaround. Foundations for nine pumps, one large compressor, two vessels, and two exchangers had to be relocated where existing equipment was in use. In order to save time after the unit came down, all center lines for these foundations had been located and marked in concrete earlier.

All new steel structures required for the job were made in the welding shop and pre-assembled close to the job site into units as large as could be conveniently handled. This reduced assembly time on the job.

The increased capacity of the unit required a new 34-inch reactor riser, 22¾-inch reactor standpipe, and 22-inch external and internal regenerator standpipes. This piping was detailed by the licensor of the unit and fabricated by an outside concern.

Table 1 shows new equipment which was installed and the disposition of some existing equipment. By replacing the open type water box main column overhead condensers with air cooled sections, it was possible to take care of the increased capacity without increasing the water rate. Prior to the revamp, 1100 gallons per minute of water was being circulated in the open water box. Presently, 1100 gpm are being circulated in the shell and tube after coolers used in conjunction with the air cooled sections.

TABLE 1

Equipment	New	Existing-Relocated	Existing to Surplus
Pumps	8	13	7
Compressors	2—16x16x8x8x12	1	0
Exchangers: Shell & Tube	10	18	13
Air Cooled Condensers	2—Replaced Open Type Water Box Overhead Condensers		

Five new vessels were installed, the largest being a 6-foot 6-inch by 70-foot debutanizer column (Figure 1). The debutanizer column was set while the cat was in operation and foundations were in place for two more of the vessels before operation stopped.

From the standpoint of normal turnaround, some work was eliminated with the addition of new equipment and redesigned piping necessary for greater capacity. Other problems were enlarged because of the long run since the last turnaround. Periodic checks of the skin temperature of the regenerator during operation indicated that the refractory liner had failed. This proved to be the case upon inspection. Arrangements had been made weeks in advance for an outside contractor to be on hand with material and equipment to repair the liner. Again planning paid dividends.

New primary cyclones were on hand for the regenerator since the last inspection indicated that these would have to be replaced after one more run. The routine turnaround items such as checking and setting all safety valves, repair of pumps, and cleaning exchangers were also performed.

Although the cat was down 35 days, only 27 were work days. Working six days a week, nine hours a day, 204 workmen and 18 supervisors worked 43,400 man-hours. Some 16,675 man-hours were charged to new construction while 26,725 man-hours were for maintenance turnaround. The primary reason for such a short down period is due to the work that was completed before the unit came down. Of 37,180 total man-hours charged to new construction, 20,505 man-hours (55 percent) were charged off before the cat cracker came off stream. A 50 percent increase in coke burning capacity was realized at a cost of $165 per barrel of incremental throughput. ##

Meet the Author

ELBERT H. BOULLIOUN, JR. graduated from the University of Texas in 1948 with a B.S. degree in business administration, and then in 1954 with a B.S. degree in mechanical engineering. After his graduation in 1954 he joined the Engineering department of Cosden Petroleum Corp. where he served as an inspection engineer for 16 months before assuming his present position as project engineer.

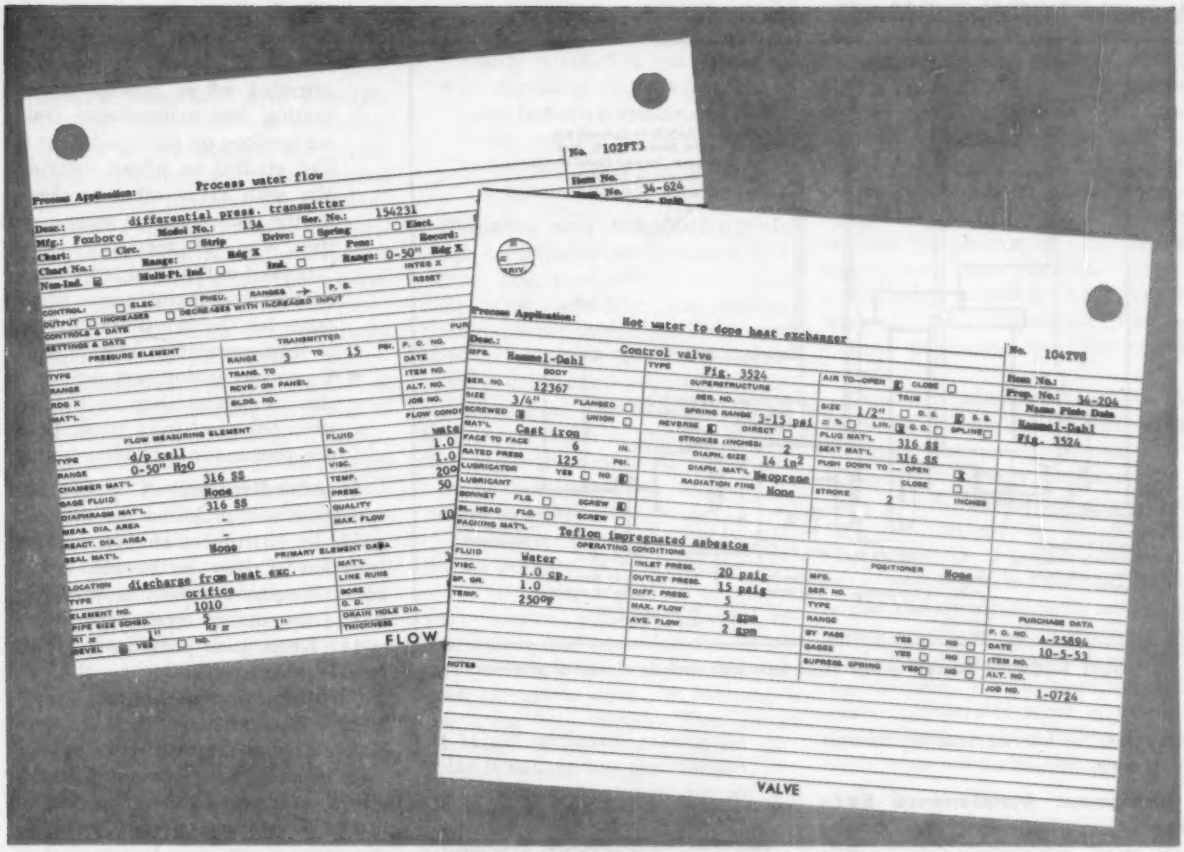


FIGURE 1 and 2—Record cards aid in trouble-shooting and calibration work.

Ways to Improve Instrument Maintenance

Increased automation requires tremendous improvements in the instrumentation field. Your instrument maintenance program must keep up and here's a way to do it.

Paul Taylor
The Chemstrand Corporation
Decatur, Ala.

THE ACCELERATED application of instruments and automation equipment in modern processes, presently being constructed, range from 5 percent to 15 percent of the total process cost. This tremendous increase in the application of process instrumentation has placed much greater importance on the proper maintenance of instruments and automatic control equipment.

The Chemstrand Corporation, in recognition of the benefits of automation, initiated a program to substantially increase the amount of instrumentation in its acrylic synthetic textile fiber plant.

Instrumentation in the chemical areas and in the power house is predominantly pneumatic while that used on the mechanical equipment is about 50-50 pneumatic and electronic. Some of the newer instrumentation includes:

(1) Completely automatic batch operation.

(2) Automatic scanning and data

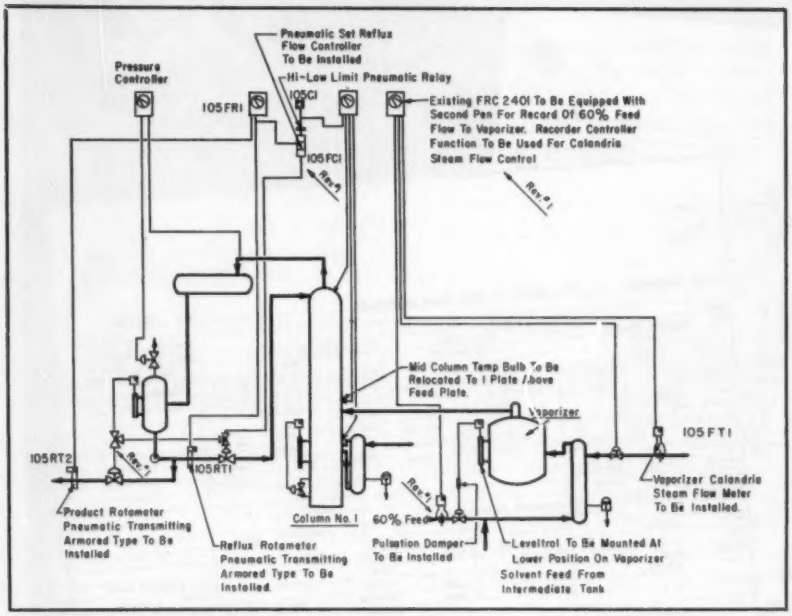

Pneumatic Set Reflux Flow Controller To Be Installed
Hi-Low Limit Pneumatic Relay
Pressure Controller
105FRI
105CI
105FCI
Existing FRC 2401 To Be Equipped With Second Pen For Record Of 60% Feed Flow To Vaporizer. Recorder Controller Function To Be Used For Calandria Steam Flow Control
Rev-1
Rev-1
Mid Column Temp Bulb To Be Relocated To 1 Plate Above Feed Plate.
Vaporizer
105FTI
105RT2
105RTI
Rev-1
Vaporizer Calandria Steam Flow Meter To Be Installed.
Product Rotameter Pneumatic Transmitting Armored Type To Be Installed
Column No. 1
60% Feed
Rev-1
Reflux Rotameter Pneumatic Transmitting Armored Type To Be Installed.
Pulsation Damper To Be Installed
Levelstrol To Be Mounted At Lower Position On Vaporizer
Solvent Feed From Intermediate Tank

FIGURE 3—Control diagram in flow sheet form aids analysis of control problems.

reduction for mechanical equipment speed measurements.

Instrument Maintenance Section—One of the first steps of the instrument improvement program was to establish an instrument maintenance section as a separate member of the plant engineering team. This new section includes instrument engineers, a foreman, mechanics, and a section supervisor. The section now has the dual responsibility of instrument maintenance and plant instrument engineering and technical assistance. Prior to this change, instrument maintenance was handled as an integral function of the normal plant maintenance section which includes all crafts such as millwrights, pipefitters, carpenters, etc. Some of the reasons for making this organizational change were as follows:

- A significant function of instrument groups is to assist operating personnel in the analysis and use of instrument readings and in the analysis and solution of process control difficulties. It was considered that the close cooperation required between instrument and operations personnel to do this effectively could better be attained through a separate instrument section.
- Due to the increasing complexity of instruments and automation equipment, strengthening of the engineering and technical talent in the maintenance section was desired.

Instrument Mechanic Training—Training of new mechanics and retraining of old mechanics was carried out over a period of about nine months with greater emphasis on actual calibration and trouble-shooting techniques. The following methods were used:

- Process engineers and supervisors conducted process orientation and familiarization sessions for instrument mechanics to give them a thorough knowledge of process equipment and operations.
- Instrument foremen and instrument engineers conducted training sessions on measurements and control principles and techniques, types of equipment, tube bending and installation.
- Various instrument vendor's engineers and servicemen conducted in-plant maintenance training sessions. These sessions ranged from one hour to three days in length. Some were handled on a service charge basis while some were conducted without cost.
- Instrument mechanics were sent to five different instrument manufacturer's factory training schools (one or two mechanics to each school). Upon their return, each mechanic who had attended school conducted calibration and maintenance training sessions on the equipment he had studied in school individually with every other mechanic in the maintenance section. In this way all mechanics were "checked-out" in the proper calibration and maintenance procedures for the five different types of instrumentation represented.
- A process analog was set up in the instrument shop so that instrument mechanics could practice pneumatic controller tuning.

Standardization—A preferred types list was prepared for use as a guide by instrument engineers in the selection of new instrument equipment. Reasons for limiting the number of instrument types were:

(1) Keep spare parts inventory at a reasonable level, and

(2) Improve maintenance proficiency by servicing similar types rather than a large variety of types.

In selecting the preferred types, an effort was made to standardize as much as possible on the most predominant types already installed in the plant. Other important factors were initial costs and installation and maintenance costs balanced against quality of performance.

One of the functions of an instrument group is to keep abreast of the latest developments in the field to fully exploit any possible improvements. In view of this fact, preferred types originally established are changed as new developments and improvements in instrument equipment warrant a change.

Standard Maintenance Procedures—Along with the selection of preferred instrument types, standard maintenance procedures for these instrument types were prepared and put in use. These procedures were for the most part, simply adopted from various instrument manufacturer's maintenance bulletins. Copies of all the procedures were combined in a standard procedure manual and each mechanic was given a copy of this manual.

These manuals were most useful during mechanic training. Most of the mechanics now know the procedures and seldom refer to the manuals. However, they were an effective

way to standardize procedures so that all mechanics perform maintenance in the same efficient manner.

Control Diagrams and Records—To aid instrument and operating personnel in the analysis of process control problems, instrument control diagrams were prepared for the plant processes. These drawings are simplified process flow sheets which also show schematically single line instrumentation and hook-up for the process. These diagrams are primarily for the use of instrument maintenance personnel, but they are also of great value to operating personnel in understanding the function of instruments in the operation of their process. Figure 3 shows a small control diagram typical of the larger process control diagrams.

In conjunction with the control diagrams, a complete instrument specification record system was established. Each plant instrument valued at $100 or more was assigned an identification symbol which identifies process area, instrument function, and process control loop number. An instrument record card was then prepared for each instrument. These cards include complete instrument specifications, calibration data and normal instrument settings. Typical record cards are shown in Figures 1 and 2. These record cards are an invaluable aid to maintenance personnel in trouble-shooting and calibration work.

Instrument Shop Layout—To improve shop efficiency, the following steps were taken:

- Industrial engineers conducted a study of instrument shop equipment and procedures and recommended an optimum equipment layout.
- Pneumatic instrument calibration and test stations were built at several of the shop work benches. These stations include precision air supply regulators and manometers covering pressure ranges from 0-50 inches of water to 0-30 psig. They were equipped with snap-in type connectors used along with ¼-inch tygon flexible tubing. Using these fittings, an instrument can be connected at the test station for calibration or alignment in a matter of seconds.
- An electronic instrument calibration and test bench was built with test instruments permanently installed in the bench.
- A complete file of instrument manufacturers maintenance bulletins was set up in the instrument shop for quick convenient use by instrument mechanics.

Planning and Scheduling—In order to improve maintenance efficiency and productivity, use of a daily work schedule was started. Under this procedure the instrument foreman prepares in the late afternoon a daily work schedule for the following day. This schedule is adhered to as much as possible, in general the only deviations being unscheduled maintenance required to sustain operations.

The success of this system requires the cooperation of operating personnel. They were requested to review their known instrument work requirements and to advise the instrument foreman of these requirements each afternoon when the foreman is preparing his schedule. This system has been effective in reducing nonproductive man hours.

Meet the Author

PAUL TAYLOR has been instrument supervisor for the Chemstrand Corp., acrilan acrylic fiber manufacturing plant at Decatur, Ala., since 1956. Before joining Chemstrand he had more than five years experience as an instrument engineer for E. I. du Pont de Nemours & Co., Inc., and Union Bag and Paper Corp. He is a native of Huntsville, Ala., and attended the University of North Dakota, and Georgia Institute of Technology from which he received a B.S. degree in chemical enginering in 1949. Taylor is a registered professional engineer in Alabama and a member of the Instrument Society of America.

Preventive Maintenance—Presently about 20 percent of the plant's instruments are inspected and/or aligned and adjusted on a routine periodic schedule. Other maintenance work is scheduled on the basis of trouble calls from operating personnel. It is planned to extend the preventive maintenance coverage until at least 50 percent of plant instruments are inspected and checked periodically according to a routine schedule. All instruments that are critical to process operation will be included.

One step already taken in this connection is the assignment of two or more instrument mechanics to various process operating areas for a daily preventive maintenance inspection. In this system the mechanic checks certain critical instruments every morning in his assigned process area. Minor adjustments and alignments are made during the inspection if they can be completed in five to ten minutes. If the inspection indicates considerable work is required, the mechanic reports this to the foreman who schedules the work as he sees fit.

Spare Parts—A program for improving the instrument spare parts system is being carried out as follows:

- Make a complete survey and inventory of existing spare parts and instrument stores items.
- Make a study of all existing process instruments to determine spare parts requirements.
- Compare the required against actual spare parts and order new or dispose of unused spares as required.

Chemstrand feels that the measures outlined above have been very effective in improving their instrument maintenance. In addition, we have plans for further improvement. These plans include:

(1) An instrument maintenance cost accounting system that will pinpoint areas or items of abnormally high maintenance cost and

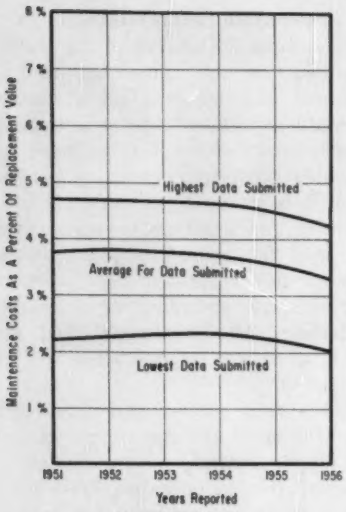
(2) An instrument engineering program aimed at instrument applications that will produce large dollar savings in plant operations.

We also believe that our instrument maintenance program must be aggressive and dynamic in order to change with the tremendous changes and improvements that characterize the instrumentation field. ##

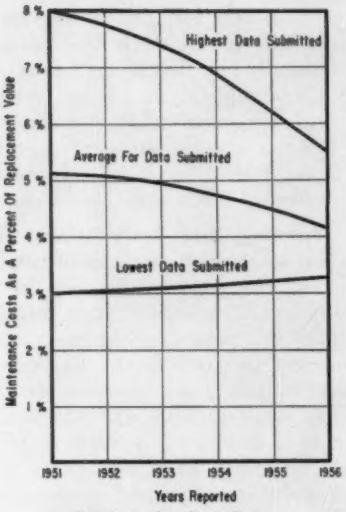
Maintenance Costs Drop

Compare your plant and units with these industry averages taken from Petroleum Refiner's survey.

We would like to express our appreciation to the many companies who made this survey possible.—The Editors.

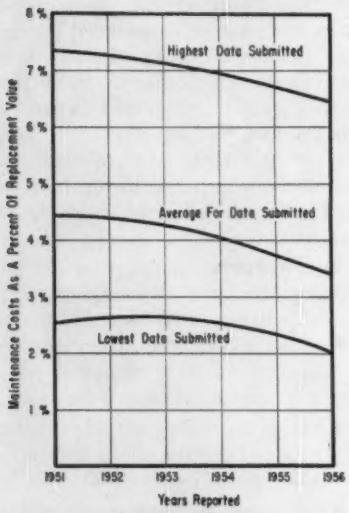


Operating Plant

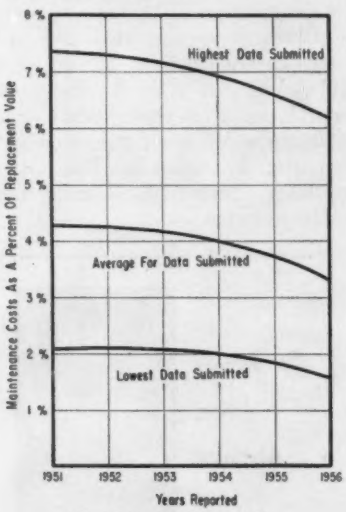


Catalytic Cracking Only

SMALL REFINERIES (LESS THAN 30,000 BPD)



Operating Plant



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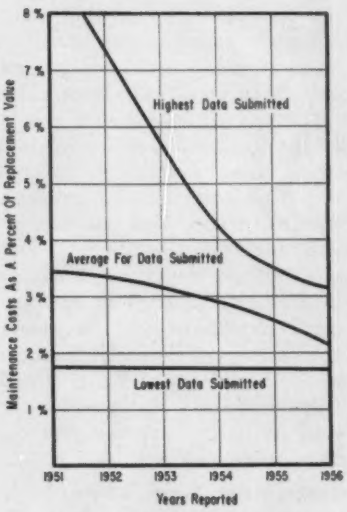
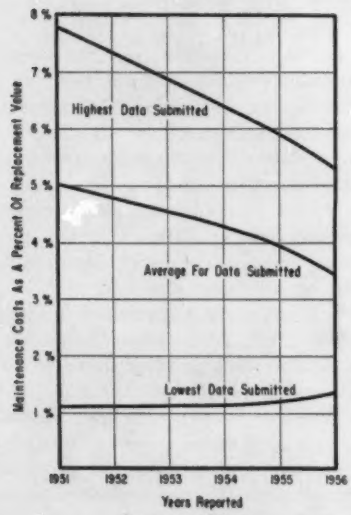
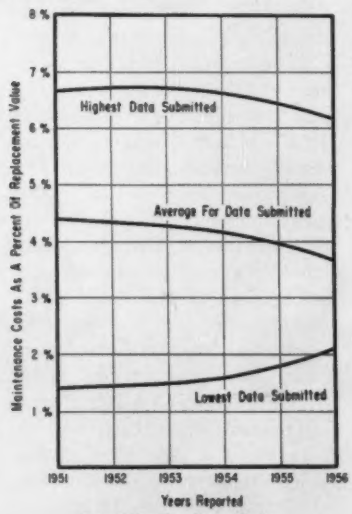


NATURAL GASOLINE PLANTS

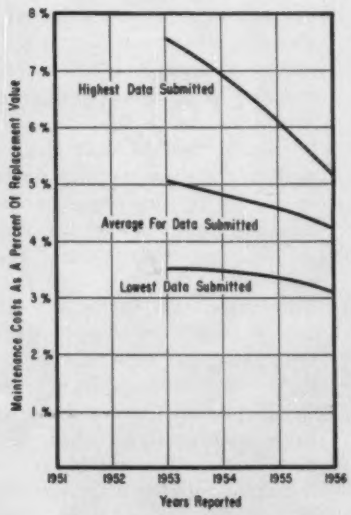
MEDIUM REFINERIES (30,000-100,000 BPD)



Operating Plant



Catalytic Cracking Only



PETROCHEMICAL PLANTS

LARGE REFINERIES (OVER 100,000 BPD)

New Ideas in Preventive Maintenance

Here's a way to have fewer production delays and less costly repairs, a combination which produces greater throughput and greater profit.

C. F. Canney
Koppers Company, Inc.
Pittsburgh

PREVENTIVE MAINTENANCE is one of two choices that Management has to keep operating equipment in production. The other choice is breakdown maintenance. The type of maintenance chosen depends on production economics.

Breakdown maintenance would be selected when obsolete equipment or an outdated process is being operated in marginal production of a temporary or emergency nature, where no long-term schedule is contemplated.

Preventive maintenance should be utilized where continued operation is expected in order to make it possible to set up firm production schedules. The best preventive maintenance schedule will only minimize breakdown maintenance and not eliminate it. Preventive maintenance must prevent something and maintenance is not the thing prevented. The only justifiable purpose for a preventive maintenance program is that it shall result in overall economies in production costs.

Initially a preventive maintenance program will increase the cost of maintenance as a direct expenditure. This may continue over a long period. In fact, the expenditure charged to maintenance may never actually go below that average established prior to initiation of preventive maintenance. Other costs, such as capital replacement, direct operating expense and increased equipment and labor efficiency, will be reduced and should be credited to the preventive maintenance program to justify it. This has to be sold to Management and resold through the early years while the P/M program is getting established.

Here are a few cardinal principles of preventive maintenance.

- Simplicity is a must. Make your P/M program as simple as possible.
- Tag each piece of capital equipment except buildings, tanks, stills, etc., which have a numbering system.
- Refer to all equipment by this tag or assigned number.
- Make (a) history cards, (b) cost cards and file in permanent, visible and easy posting holders.
- Use service orders for all work performed.
- Provide proper storage for parts and supplies. Make a ledger of all items to be carried, if a small plant, or install a perpetual inventory in large plants.
- Keep records up to date.
- Put all equipment in good operating condition before attempt-

Meet the Author

C. F. CANNEY is a member of Koppers Co., Inc., Pittsburgh, Pa. As assistant chief engineer, his duties involve engineering and erection of new construction, and assisting with major maintenance and repairs for the Tar Products division. Canney started with Koppers in 1928 and was located at Follansbee W. V. for 20 years. He started as a clerk, then continued through various jobs including five years with instruments, eight years as assistant master mechanic. He was transferred to Pittsburgh where he spent four years as a combustion engineer, and four years as supervisor of all construction and major maintenance in all plants of the division before being promoted to his present position.

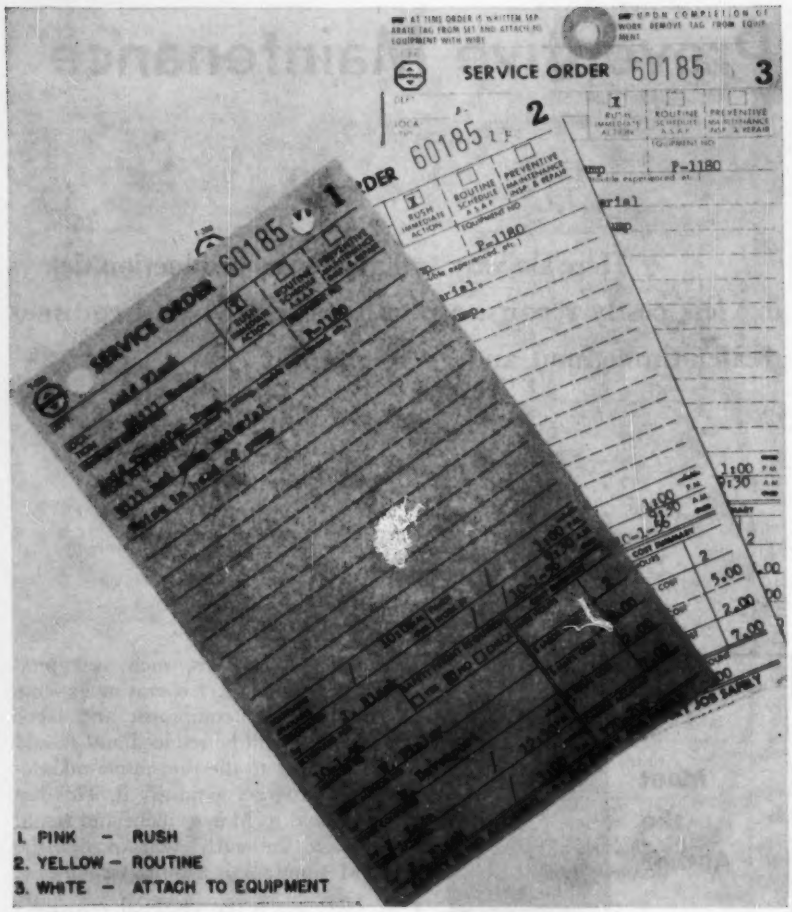


FIGURE 1—Card type forms speed up repair system.

ing to set up preventive maintenance on it.

- Establish firm shutdown inspection schedules and adhere to them. These schedules may be varied as your preventive maintenance experience shows that longer or shorter cycles should be established. Make check lists for all preventive maintenance inspections, developing a schedule for replacement and repairs from information so obtained.
- To enjoy the benefits of preventive maintenance, which must be reduced overall cost and firmer production schedules, continuing control has to be established. At the same time the system must be sufficiently flexible to pick up and establish changes in process and equipment which the system itself develops. This returns us to our first cardinal principle of simplicity.

This presentation will cover the establishment of a preventive maintenance program in the 23 operating plants of the Tar Products Division of Koppers Company, Inc. The problems involved, although not unique, may be considerably different from those occurring in establishment of such a program in a single, large operation or a small number of similarly sized operations. The Tar Products Division plants range from a complex chemical operation, employing about 300 men, to small service stations with less than 10 employees and all intermediate sizes.

The system must be flexible enough to apply to all sizes. Control must be largely centralized in the main office of the Division because it is impossible to maintain a sufficient variety of talents in all plants.

A partial preventive maintenance program was in operation. This was set up to cover periodic inspection and repairs of major operating units, stills and boilers. It was accomplished by means of a single-part Job Order, Inspection Check List on visible record.

This system was adequate for periodic inspection and overhauls of the items integrated into the major operating unit. It did not provide an efficient method of handling the individual items or components of the major unit, as well as similar items not connected to these units. An example of these are pumps, instruments, compressors, etc. These were handled at each plant by their own procedure for repairs and emergencies. They consisted of a variety of forms and oral instructions.

Disadvantages of the old system:

- It was difficult to schedule the work to be done.
- There was inadequate check and control of maintenance costs on individual equipment.
- Minor, non-integrated property items were frequently overlooked in scheduling preventive maintenance.
- There was a tendency to by-pass safety procedures.

New Preventive Maintenance Program—In inaugurating the preventive maintenance program, it was necessary to segregate all phases of such a program into appropriate subdivisions. The following six steps were the guide to our efforts to the desired goal.

1. Provide an adequate maintenance budget.
2. Set up an equipment record system.
3. Check on the condition of existing equipment.
4. Develop adequate stocks of renewal parts.
5. Plan maintenance shutdowns well in advance.
6. Follow approved maintenance practices.

Now to enlarge upon these steps.

1. Provide an adequate maintenance budget—At this point, it was necessary to go to top manage-

ment and explain the program in order that they would recognize the importance of making available a budget sufficiently large to make this program work. All plants were surveyed for obsolete and worn-out equipment. We set up a program to bring each plant up to a point where preventive maintenance could be practiced instead of "rush" breakdown repairs.

2. Set up an equipment record and service order system—An equipment record system is a vital part of a preventive maintenance program. It provides "case histories" of each piece of equipment to guide workers in carrying out, on a planned basis, such jobs as periodic inspection, routine cleaning, etc. Also from these "case histories" it is possible to recommend replacement of one make or type of equipment with another on the basis of life expectancy, lost time due to breakdowns, or maintenance costs. In cases where there is repetitive repair work, it provides a signal for a study of method improvement and equipment application to cut down on future repair time. Such "case histories" may also justify the need of equipment redesign.

The logical procedure starting from scratch would be to start by inspection and tagging of equipment, followed by establishment of a "history card" record system and then set up the repair order to establish preventive maintenance. However, since a suitable repair order system had been partly established and the job of equipment tagging and history card record was a formidable one with 23 plants, we actually worked on all phases at once in some locations. The service order system was first established uniformly because it was available. This was followed by tagging and history card records. The following service order system was developed.

A three-part *Speediset* service order (Figure 1) was developed to minimize the deficiencies of the previous system. Except for periodic inspection and repair of major operating units, this form efficiently facilitates and routinizes the requesting, authorizing, scheduling, execution, cost determination and distribution on any type of work whether it be maintenance and repair, alterations, construction, renovation, salvage or preventive maintenance inspection. The form permits color-keyed classification as "Rush" or "Routine," and serves as a constant reminder of the importance of safety.

FIGURE 2—Brass tags offer permanent equipment records.

Form Features—Parts 1 and 2 are printed on permafibre paper as this stock withstands rough handling and dirt. Part 3 is on heavy card stock with reinforced eyelet to permit attaching this part to the equipment requiring service.

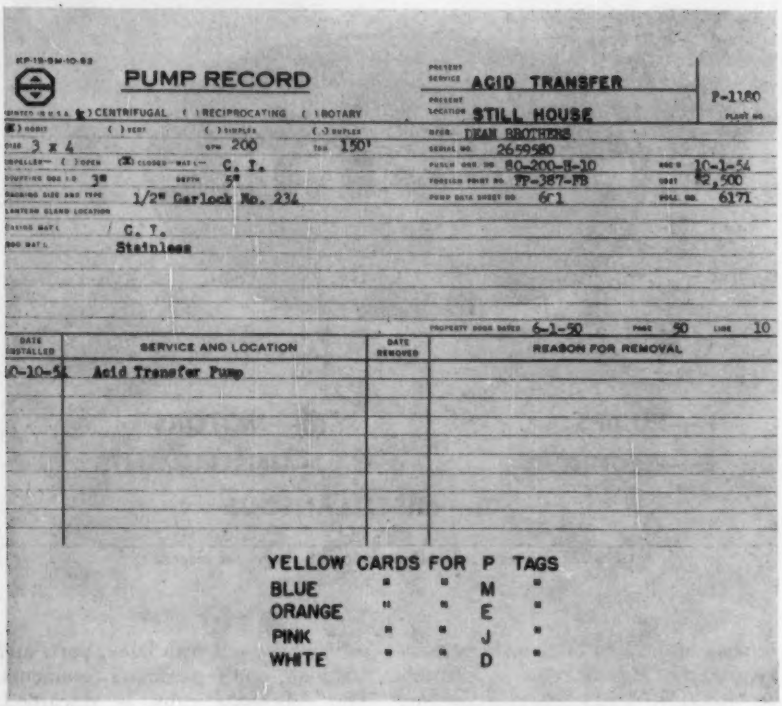
Foremen carry a supply of these forms. Whenever any equipment requires repair, the foreman reports the condition and requests action by completing the top portion. Foreman removes part 3 and wires to the equipment or control panel. This warns all personnel that the equipment is in need of repair and assists the maintenance men in locating the equipment.

Parts 1 and 2 of the *Speediset* form are sent to the master mechanic or plant engineer for scheduling. The order is reviewed to determine the urgency and whether or not a safety permit is required. Group leader assigns the work following receipt of pink part marked 1, if "Rush," or yellow part 2, if "Routine." The remaining part is retained for follow-up purposes by the master mechanic or plant engineer.

Following completion of the work, part 1 or 2 is returned to the master mechanic or plant engineer, completely filled out with labor, parts and materials, and repairman's comments. The follow-up copy is discarded. Labor and materials are costed on the form and posted to the maintenance and repair cost record card. Costed orders are sorted according to account-to-be charged and the amount chargeable to each department. The order is then filed according to department and equipment. The plant superintendent uses this file to assist in minimizing expensive "Rush" jobs and controlling maintenance costs.

Additionally, the *Speediset* is used to schedule preventive maintenance inspection on small pieces of operating equipment. Equipment description, tag number, and inspection date are noted on the set which is then filed.

Service order sets for preventive maintenance inspection are removed from the file ahead of the due date and given to the group leader. The complete set is given to the mechanic and inspection made on or before the due date at his convenience. If the equipment does not require repairs, the date of inspection, findings and services rendered (such as lubrication) are noted on the order which is returned to the master mechanic; parts 1 and 3 are discarded, part 2 is costed, posted to the card record and filed. In the event that repairs



PUMP RECORD

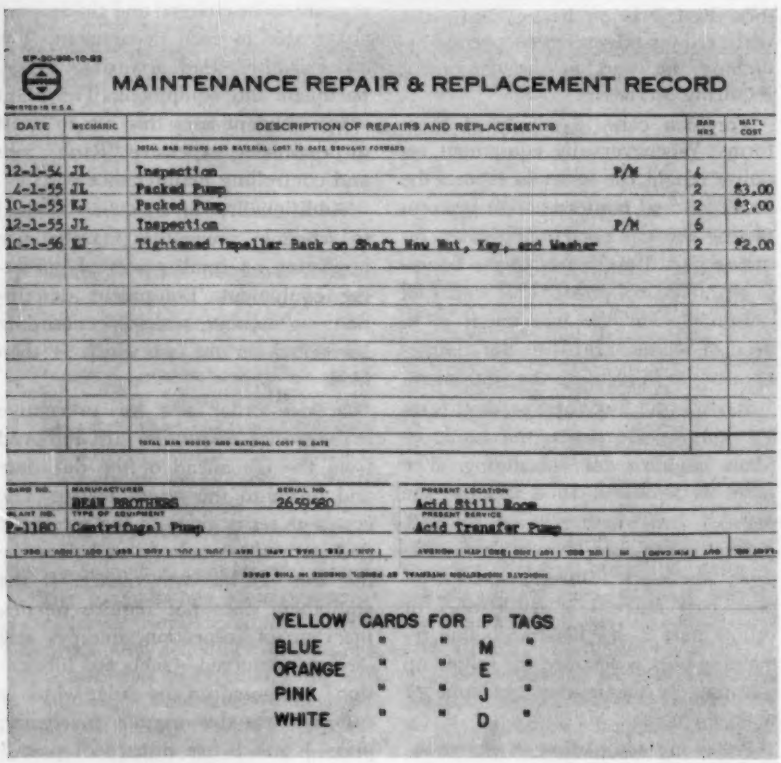
SERVICE: ACID TRANSFER
PRESENT LOCATION: STILL HOUSE
P-1180
MFGR.: DEAN BROTHERS
SERIAL NO.: 2659580
PUMP ORD. NO.: 80-200-H-10
FOREIGN PROJ. NO.: FP-387-FB
PUMP DATA SHEET NO.: 6-1
MDL. NO.: 6171
PROPERTY BOOK DATED: 6-1-50 PAGE: 50 LINE: 10

( ) CENTRIFUGAL ( ) RECIPROCATING ( ) ROTARY
( ) HORIZ ( ) VERT ( ) SINGLE ( ) DUPLEX
SIZE: 3 x 4 GPM: 200 TDH: 150'
( ) OPEN (X) CLOSED MAT'L: C. I.
DEPTH: 5"
PACKING SIZE AND TYPE: 1/2" Garlock No. 234
LANTERN RING LOCATION
CASING MAT'L: C. I.
IMP. MAT'L: Stainless

DATE INSTALLED	SERVICE AND LOCATION	DATE REMOVED	REASON FOR REMOVAL
10-10-54	Acid Transfer Pump		

YELLOW CARDS FOR P TAGS
BLUE " " M "
ORANGE " " E "
PINK " " J "
WHITE " " D "

FIGURE 3—Manufacturers' data are kept on these records which are color coded.



MAINTENANCE REPAIR & REPLACEMENT RECORD

DATE	MECHANIC	DESCRIPTION OF REPAIRS AND REPLACEMENTS	MAN HRS	MAT'L COST
		TOTAL MAN HOURS AND MATERIAL COST TO DATE BROUGHT FORWARD		
12-1-54	JL	Inspection P/M	4	
4-1-55	JL	Packed Pump	2	$3.00
10-1-55	KJ	Packed Pump	2	$3.00
12-1-55	JL	Inspection P/M	4	
10-1-56	KJ	Tightened Impeller Back on Shaft New Nut, Key, and Washer	2	$2.00
		TOTAL MAN HOURS AND MATERIAL COST TO DATE		

CARD NO. | MANUFACTURER: DEAN BROTHERS | SERIAL NO.: 2659580 | PRESENT LOCATION: Acid Still Room
PLANT NO.: P-1180 | TYPE OF EQUIPMENT: Centrifugal Pump | PRESENT SERVICE: Acid Transfer Pump

YELLOW CARDS FOR P TAGS
BLUE " " M "
ORANGE " " E "
PINK " " J "
WHITE " " D "

FIGURE 4—Maintenance record carries the same color card as all other cards for that type of equipment.

are required, the mechanic completes the upper portion, removes part 3, attaches same to the equipment, and returns parts 1 and 2 to the master mechanic who processes in the manner described for service orders originated by a foreman.

Tagging Equipment—Along with the service orders, card records and tagging of equipment were necessary.

Tags made of brass were ordered. An oval plate 1 inch x 2 inches (Figure 2) was made with holes in each end for pinning the tag, in a permanent manner, to the equipment. These tags were allocated to the plants from the Central Office and a record made of the numbers. The equipment to be tagged was set up in five categories, not including major production units such as stills and boilers, which are handled on special, more complex forms.

P tags—for pumps.

M tags—for motors.

E tags—for electrical equipment, starters, safety switches, transformers, etc.

J tags—for instruments (recorders, controllers, control valves and transmitters).

D tags—for general, condensers, unit heaters, car hauls, machine tools, lift trucks and other material not classified by the P,M,E and J tags.

All the equipment was examined for serial numbers and manufacturers' data and then tagged. Obsolete equipment was found during this survey with no previous records; all this was noted for our future program.

Card Records—As the equipment was tagged, the manufacturer's data was entered on the appropriate record card (Figure 3) with the tag number in the upper right corner, marked "Plant No." The number was placed on the very top of the card so it could be seen when it was put in the card file. The record card was then filled out with all the information that could be gathered from that particular piece of equipment. A section on the card for "present service" and "present location" was printed in pencil so it could be changed when the equipment was moved. A color system of record cards was used.

Yellow cards are for P-tags.

Blue cards are for M-tags.

Orange cards are for E-tags.

Pink cards are for J-tags.

White cards are for D-tags.

Maintenance Repair and Replace-

ment Record Cards—A second card (Figure 4) using the same color scheme as the record cards was used in conjunction with the equipment record. On this card all the repair expenses were posted. P/M was the marking to denote a preventive maintenance inspection. In this manner a permanent record of cost on each piece of equipment was kept. If equipment was transferred from one plant to another, the tag remained on the equipment and both record and maintenance cards were forwarded to the receiving plant. As soon as a new piece of equipment is received in a plant, it is immediately tagged and carded.

Major Operating Units—These units consist of stills and are not tagged. A special two-page form (Figures 5 and 6) is provided for the still inspection. On this form are printed the items to be inspected during the shutdown. These forms are filed for each unit and referred to for future maintenance and replacements.

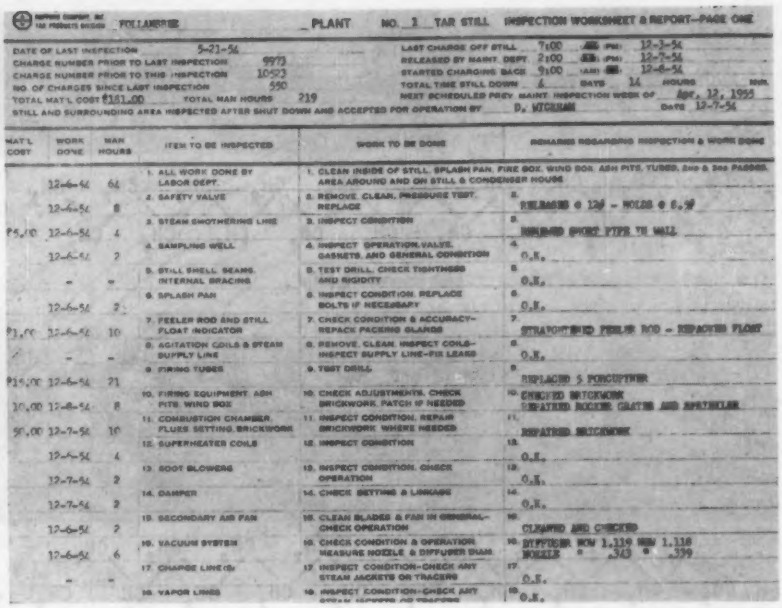
3. Check on the condition of our equipment—This was the starting point of the preventive maintenance program for each piece of equipment. We had to establish the present condition, by visual inspection or taking the equipment apart for examination as operations would permit. Past history was then established either from records or verbally. Past frequency of breakdowns, the severity of service and the expected life remaining were also developed as accurately as possible. From this information, a tentative preventive maintenance inspection, repair and maintenance program was set up and the record card started. This card is the guide for future modification of the cycle for inspection, repair and replacement of the equipment. This particular item is now started on preventive maintenance.

4. Develop adequate stocks of renewal parts—Initially it is necessary to set up a stock of repair and replacement parts, based on an educated guess of replacement or repair frequencies. As information is developed on the P/M record card, it will be possible to adjust the inventory of these repair and replacement parts to fit the schedules established by the P/M program.

5. Plan maintenance shutdowns well in advance—Planned shutdowns are undertaken only after the production needs of each department have been consulted. This permits co-ordinating activities so that only a minimum loss of production will be experienced.

6. Follow approved maintenance practices—Along this line we follow the recommendations of the manufacturers of our equipment and lubrication suppliers. In case of much of our major equipment which is unique with Koppers Co., we must rely on past experience and recommendations of our own people. Here the equipment records will be invaluable as we will not always have the same personnel, and, further, man's memory is not infallible.

The value of preventive maintenance cannot be proved as yet (due to lack of comparable records of previous performance). However, we are having fewer production delays and less costly repairs. We can show greater throughput and greater profit for which better operation and better equipment maintenance must be given their share of credit. ##

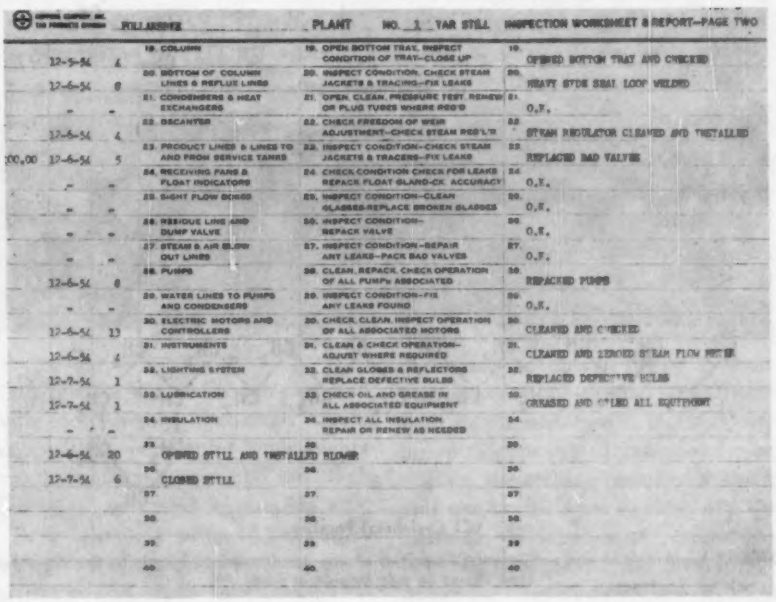


FOLLANSBEE _ PLANT NO. 1 TAR STILL INSPECTION WORKSHEET & REPORT—PAGE ONE

DATE OF LAST INSPECTION 5-21-54
CHARGE NUMBER PRIOR TO LAST INSPECTION 9973
CHARGE NUMBER PRIOR TO THIS INSPECTION 10523
NO. OF CHARGES SINCE LAST INSPECTION 550
TOTAL MAT'L COST $181.00 TOTAL MAN HOURS 219
STILL AND SURROUNDING AREA INSPECTED AFTER SHUT DOWN AND ACCEPTED FOR OPERATION BY D. WITCHAN

LAST CHARGE OFF STILL 7:00 (AM) (PM) 12-3-54
RELEASED BY MAINT. DEPT 2:00 (AM) (PM) 12-7-54
STARTED CHARGING GAS 9:00 (AM) (PM) 12-8-54
TOTAL TIME STILL DOWN 4 DAYS 14 HOURS
NEXT SCHEDULED PREV. MAINT. INSPECTION WEEK OF Apr. 12, 1955
DATE 12-7-54

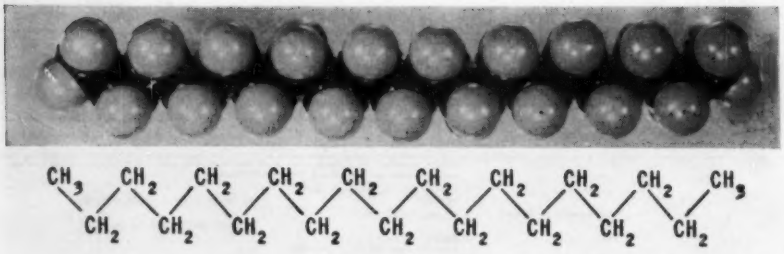
MAT'L COST	WORK DONE	MAN HOURS	ITEM TO BE INSPECTED	WORK TO BE DONE	REMARKS REGARDING INSPECTION & WORK DONE
	12-6-54	64	1. ALL WORK DONE BY LABOR DEPT.	1. CLEAN INSIDE OF STILL, SPLASH PAN, FIRE BOX, WIND BOX, ASH PITS, TUBES, End & Side PASSES, AREA AROUND AND ON STILL & CONDENSER HOUSE	1.
	12-6-54	8	2. SAFETY VALVE	2. REMOVE, CLEAN, PRESSURE TEST, REPLACE	2. RELEASED @ 120 – HOLDS @ 8.#
75.10	12-6-54	4	3. STEAM SMOTHERING LINE	3. INSPECT CONDITION	3. REMOVED SHORT PIPE TO WELL
	12-6-54	2	4. SAMPLING WELL	4. INSPECT OPERATION, VALVE, GASKETS, AND GENERAL CONDITION	4. O.K.
	–	–	5. STILL SHELL, BEAMS, INTERNAL BRACING	5. TEST DRILL, CHECK TIGHTNESS AND RIGIDITY	5. O.K.
			6. SPLASH PAN	6. INSPECT CONDITION, REPLACE BOLTS IF NECESSARY	6. O.K.
	12-6-54	2	7. FEELER ROD AND STILL FLOAT INDICATOR	7. CHECK CONDITION & ACCURACY—REPACK PACKING GLANDS	7. STRAIGHTENED FEELER ROD – REPACKED FLOAT
93.00	12-6-54	10	8. AGITATION COILS & STEAM SUPPLY LINE	8. REMOVE, CLEAN, INSPECT COILS—INSPECT SUPPLY LINE—FIX LEAKS	8. O.K.
	–	–	9. FIRING TUBES	9. TEST DRILL	9. REPLACED 5 FORCUTTHER
915.00	12-6-54	21	10. FIRING EQUIPMENT, ASH PITS, WIND BOX	10. CHECK ADJUSTMENTS, CHECK BRICKWORK, PATCH IF NEEDED	10. CHECKED BRICKWORK REPAIRED ROCKER GRATES AND APPLIANCES
30.00	12-6-54	8	11. COMBUSTION CHAMBER, FLUES SETTING, BRICKWORK	11. INSPECT CONDITION, REPAIR BRICKWORK WHERE NEEDED	11. REPAIRED BRICKWORK
50.00	12-7-54	10	12. SUPERHEATER COILS	12. INSPECT CONDITION	12. O.K.
	12-6-54	4	13. SOOT BLOWERS	13. INSPECT CONDITION, CHECK OPERATION	13. O.K.
	12-7-54	2	14. DAMPER	14. CHECK SETTING & LINKAGE	14. O.K.
	12-7-54	2	15. SECONDARY AIR FAN	15. CLEAN BLADES & FAN IN GENERAL—CHECK OPERATION	15. CLEANED AND CHECKED
	12-6-54	2	16. VACUUM SYSTEM	16. CHECK CONDITION & OPERATION, MEASURE NOZZLE & DIFFUSER DIAMS	16. DIFFUSER NO# 1.119 NO# 1.118 NOZZLE " .343 " .339
	12-6-54	6	17. CHARGE LINE(S)	17. INSPECT CONDITION—CHECK ANY STEAM JACKETS ON TRACERS	17. O.K.
	–	–	18. VAPOR LINES	19. INSPECT CONDITION—CHECK ANY	18. O.K.



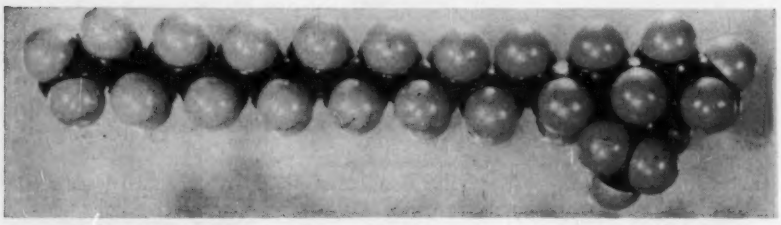
FOLLANSBEE _ PLANT NO. 1 TAR STILL INSPECTION WORKSHEET & REPORT—PAGE TWO

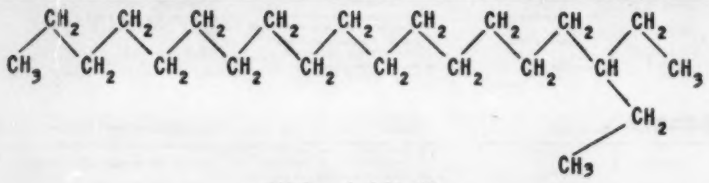
	12-5-54	4	19. COLUMN	19. OPEN BOTTOM TRAY, INSPECT CONDITION OF TRAY—CLOSE UP	19. OPENED BOTTOM TRAY AND CHECKED
	12-6-54	8	20. BOTTOM OF COLUMN LINES & REFLUX LINES	20. INSPECT CONDITION, CHECK STEAM JACKETS & TRACING—FIX LEAKS	20. HEAVY SYDE STEAM LOOP WELDED
	–	–	21. CONDENSERS & HEAT EXCHANGERS	21. OPEN, CLEAN, PRESSURE TEST, RENEW OR PLUG TUBES WHERE REQ'D	21. O.K.
			22. DECANTER	22. CHECK FREEDOM OF WEIR ADJUSTMENT—CHECK STEAM REG'LR	22. STEAM REGULATOR CLEANED AND INSTALLED
	12-6-54	4	23. PRODUCT LINES & LINES TO AND FROM SERVICE TANKS	23. INSPECT CONDITION—CHECK STEAM JACKETS & TRACERS—FIX LEAKS	23. REPLACED BAD VALVES
200.00	12-6-54	5	24. RECEIVING PANS & FLOAT INDICATORS	24. CHECK CONDITION CHECK FOR LEAKS REPACK FLOAT GLAND-CK. ACCURACY	24. O.K.
	–	–	25. SIGHT FLOW BOXES	25. INSPECT CONDITION—CLEAN GLASSES-REPLACE BROKEN GLASSES	25. O.K.
	–	–	26. RESIDUE LINE AND DUMP VALVE	26. INSPECT CONDITION—REPACK VALVE	26. O.K.
	–	–	27. STEAM & AIR BLOW OUT LINES	27. INSPECT CONDITION—REPAIR ANY LEAKS—PACK BAD VALVES	27. O.K.
			28. PUMPS	28. CLEAN, REPACK, CHECK OPERATION OF ALL PUMPS ASSOCIATED	28. REPACKED PUMPS
	12-6-54	8	29. WATER LINES TO PUMPS AND CONDENSERS	29. INSPECT CONDITION—FIX ANY LEAKS FOUND	29. O.K.
	–	–	30. ELECTRIC MOTORS AND CONTROLLERS	30. CHECK, CLEAN, INSPECT OPERATION OF ALL ASSOCIATED MOTORS	30. CLEANED AND CHECKED
	12-6-54	13	31. INSTRUMENTS	31. CLEAN & CHECK OPERATION—ADJUST WHERE REQUIRED	31. CLEANED AND ZEROED STEAM FLOW METER
	12-6-54	4	32. LIGHTING SYSTEM	32. CLEAN GLOBES & REFLECTORS REPLACE DEFECTIVE BULBS	32. REPLACED DEFECTIVE BULBS
	12-7-54	1	33. LUBRICATION	33. CHECK OIL AND GREASE IN ALL ASSOCIATED EQUIPMENT	33. GREASED AND OILED ALL EQUIPMENT
	12-7-54	1	34. INSULATION	34. INSPECT ALL INSULATION, REPAIR OR RENEW AS NEEDED	34.
	–	–	35.	35.	35.
	12-6-54	20	OPENED STILL AND INSTALLED BLOWER	36.	36.
	12-7-54	6	CLOSED STILL	37.	37.
			37.	38.	38.
			38.	39.	39.
			39.	40.	40.
			40.		

FIGURES 5 and 6—Inspection of major items is carried on these forms.

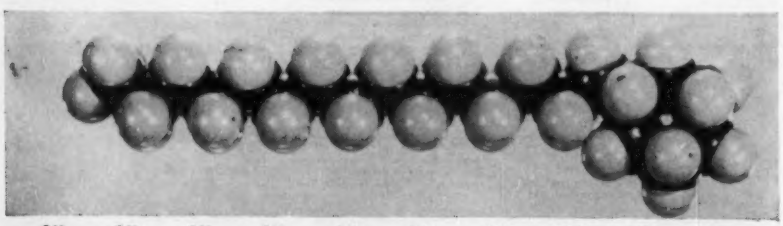


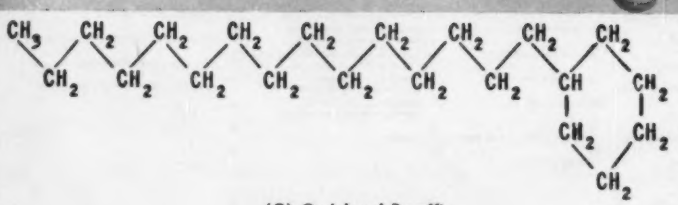
(A) Normal Paraffin





(B) Branched Paraffin





(C) Cyclohexyl Paraffin

FIGURE 1—Models of wax components: Properties of wax are determined largely by the way these long chains lie side by side in solids.

A New Look at Paraffin Waxes

Their specs are getting more rigid. Here's how composition affects wax properties.

R. T. EDWARDS
Socony Mobil Oil Company, Inc.
Brooklyn, New York

THE MANUFACTURE of wax has been an art, with little in the way of sound scientific information available to act as a guide to operation. This article gives some of the information obtained in a research program on the composition and properties of paraffin wax. The object of this program is to provide a better guide for the refiner in meeting current quality demands and facilitate development of waxes to meet the many new requirements.

The first step has been to establish the composition of representative waxes and relate this to performance in standard tests and field trials. The significant results to date concern the effect of the percentage of non-normal hydrocarbons on wax properties. The term non-normal hydrocarbons includes all hydrocarbons, other than the straight-chain normal paraffin, such as branched and cyclic compounds.

Maximum performance in many tests, for instance, tensile strength and resistance to water vapor transmission, depends on the presence of an optimum quantity of non-normal hydrocarbons of the proper type. There is no indication that differences in the chemical structure of the various non-normal types present have any effect. However, the physical state of the blend of hydrocarbons appears to be vital. An effective non-normal component must be hard and tough at the test or use temperature. Soft or liquid components of this type impair both test and field performance. The following pages give details on the determinations of compositions of representative waxes and the effect of composition on their properties. While it is impossible to set up quantitative relationships between composition and properties this work is providing a valuable guide for refining and blending operations.

Components of Paraffin Wax—The number of different chemical compounds that may be present in crude petroleum staggers the imagination and reaches astronomical figures. Only a relatively few of these solidify

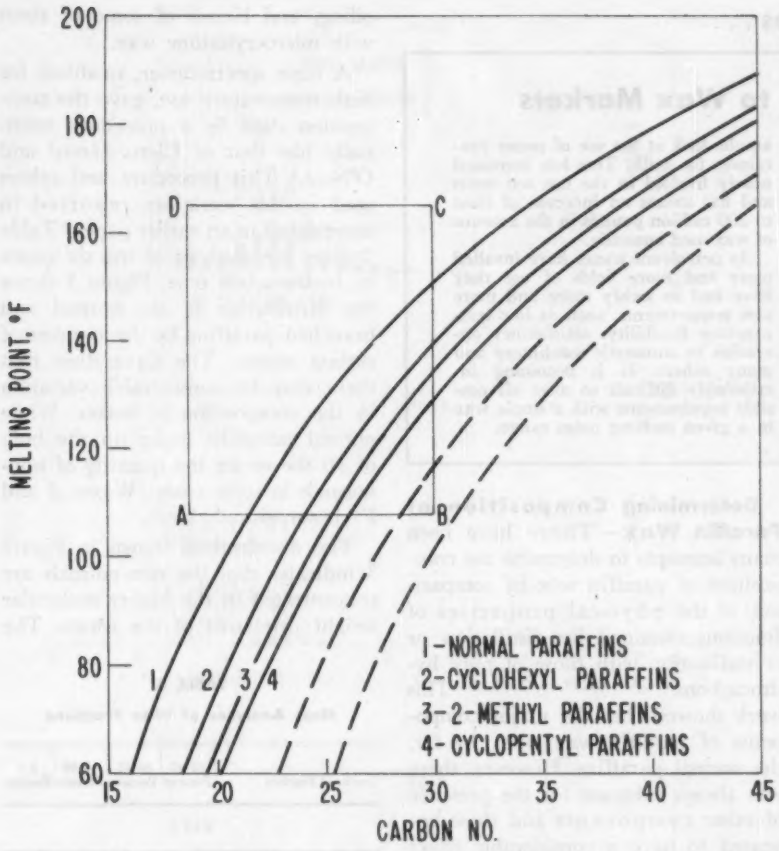


FIGURE 2. Melting points of hydrocarbons: They converge as carbon number increases.

at room temperature and it is these that appear in paraffin wax. Figure 1 shows examples of higher melting hydrocarbons, typical of those found in paraffin wax. These are shown in the form of both models and structural formulas. The pictured compounds are representative of three series of hydrocarbons, normal paraffins, 3-ethyl paraffins and 1-cyclohexyl paraffins. All are characterized by a long zig-zag chain of carbon atoms. (The chains pictured are somewhat shorter than those found in wax components.)

The last two series have more complicated groups of atoms at the end of the chain forming molecules which have almost the shape of a rod with a lump at the end. Other series of similarly shaped molecules based on cyclopentane and benzene rings exist. Many other hydrocarbon types with more complicated ring systems, more than one carbon chain per ring and with more highly branched chains also exist in petroleum. Some higher members of these series also melt high enough to be found in paraffin wax.

It is hydrocarbons of these types with 20 or more carbon atoms in an unbranched chain that concern us here. The properties of paraffin wax appear to be determined largely by the way these long chains lie side by side in the solid.

Figure 2 shows the melting points of several series of these hydrocarbons plotted against the number of carbon atoms per molecule. The data used are those given by API Research Project 44[16] supplemented by a literature review. These are not enough data available for us to draw similar curves for other hydrocarbon series but some of them must follow the course of the broken lines closely.

Here's what happens when we apply conventional refining procedures to a mixture of hydrocarbons like crude petroleum. Distillation, the first step, separates the components essentially by the number of carbon atoms. The rough limits in a distillate containing a low melting wax will be 18 to 30 carbon atoms as shown by lines *AD* and *BC* in Figure 2. Later dewaxing and deoiling steps will separate the higher melting components, say those melting above 108 F., as paraffin wax. Again, this limit, shown by the line *AB* of Figure 2, is not sharp. Looking at the figure, we see that our wax should contain a rather wide range of normal paraffins together with a certain quantity of hydrocarbons of other types.

These will largely be slightly branched paraffins or compounds with a single ring at the end of a long chain. In general they have a higher molecular weight and a lower melting point than the average normal paraffin components. There will also be quite small quantities of more highly branched compounds and more complicated ring structures. These will be in the highest molecular weight and lowest melting fractions of the wax.

The curves of Figure 2 converge as the carbon number increases. If a higher boiling distillate is considered in the same manner or before, a larger proportion of non-normal constituents than in the first case is found. Coming to microcrystalline waxes from residua, the melting points of normals and non-normals are so close and the latter so abundant in the crude that complex non-normal mixtures largely determine the properties of these waxes.

Melting and Transition Points—Paraffin waxes are usually classified by melting point. For many applications, the transition point is just as important. Mixtures of normal paraffin hydrocarbons can crystallize in two forms. One of these develops initially when the molten wax solidifies. On further cooling to about 15-30 F. below the melting point the crystalline arrangement changes to one stable at low temperatures. The temperature of change is the transition point. On cooling through transition

What's Happening to Wax Markets

In recent years the refining and marketing of petroleum waxes have taken a more and more important place in the activities of petroleum companies. Production has reached and exceeded 1 billion pounds per year with an annual dollar value near $100 million. At the same time standards in terms of service requirements have become more exacting. For many uses, it would be difficult to sell, today, products considered standard twenty years ago. The expansion of the market for waxes has been due to their increasing use in food packaging. For example, look at the use of paper containers for milk. This has increased nearly fivefold in the last ten years and has meant an increase of close to 200 million pounds in the amount of wax used annually.

As petroleum waxes have invaded more and more fields of use they have had to satisfy more and more new requirements, such as low temperature flexibility, satisfactory operation in automatic machinery and many others. It is becoming increasingly difficult to meet all possible requirements with a single wax in a given melting point range.

the wax evolves heat, equal to about one-third that of fusion, and shrinks.

The high temperature crystals are soft and plastic while the low temperature arrangement gives a hard product. Most commercial waxes contain a certain amount of material in both crystalline states as well as a very small quantity of liquid in the form of oil. The properties of a wax are determined to a considerable extent by the relative quantity of material in the two crystal forms. The amount of oil is also important and is so definitely deleterious in most applications that is kept at a minimum in refined waxes.

TABLE 1
Characteristics of Waxes

WAX	Melting Point (ASTM) °F.	Oil, (ASTM)	Tensile Strength Lbs./Sq. In. Tinius-Olsen	Tensile Strength Lbs./Sq. In. Inclined Plane (4)
A	123.2	<0.2	352	312
A, deoiled*	.....	<0.2	....	381
A, 95 percent overhead, deoiled*	.....	<0.2	....	340
B	127.0	0.3	220	214
B, plus microcrystalline wax:				
1 percent	.....	....	....	338
2 percent	.....	....	....	350
3 percent	.....	....	....	366
5 percent	.....	....	....	332
7 percent	.....	....	....	366
10 percent	.....	....	....	268
15 percent	.....	....	....	310
20 percent	.....	....	....	348
B, deoiled	.....	<0.2	....	319
B, deoiled plus microcrystalline wax:				
1 percent	.....	....	....	332
3 percent	.....	....	....	375
C	136.0	<0.2	408	358
C, deoiled	.....	<0.2	....	442
D	136.4	<0.2	440	428
D, deoiled	.....	<0.2	....	400
E	138.6	<0.2	292	270
E, plus microcrystalline wax:				
1 percent	.....	....	....	394
2 percent	.....	....	....	380
3 percent	.....	....	....	384
5 percent	.....	....	....	393
7 percent	.....	....	....	403
10 percent	.....	....	....	388
E, deoiled	.....	<0.2	....	390
F	145.2	0.5	292	283
F, deoiled	.....	....	....	354

* Deoiled with ethylene dichloride at 0 °F. Other waxes were deoiled with equal parts of benzene and methyl ethyl ketone.

Determining Composition of Paraffin Wax—There have been many attempts to determine the composition of paraffin wax by comparison of the physical properties of fractions obtained by distillation or crystallization with those of pure hydrocarbons.[2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 17] This work showed that the major components of paraffin wax were, by far, the normal paraffins. However, there was always evidence for the presence of other components and these appeared to have a considerable effect on wax properties.

Modification of the mass spectrometer for high temperature use has given a new tool for the analysis of waxes and other petroleum products that are not volatile at ordinary temperatures.[1, 14] Two recent reports illustrate the use of this instrument in showing relationships between composition and properties of paraffin wax.[5, 18]

Compositions of Representative Waxes—This section gives data on the composition of six waxes, all of known performance in service. Table 1 lists their characteristics together with tensile strength data on the waxes, before and after rigorous deoiling, and blends of some of them with microcrystalline wax.

TABLE 2
Mass Analyses of Original Waxes

WAX	A	B	C	D	E	F
Normal Paraffins, percent	75.5	94.0	86.4	81.9	82.2	66.5
Branched Paraffins, percent	13.5	2.6	6.3	10.4	8.2	17.9
Monocycloparaffins, percent	10.2	3.4	7.1	7.4	9.0	13.4
Polycycloparaffins, percent	0.6	0.0	0.1	0.3	0.5	1.9
Monocyclic aromatics, percent	0.2	0.0	Trace	0.0	0.1	0.3
Aromatic cycloparaffins, percent	0.0	0.0	0.0	0.0	0.0	Trace

A mass spectrometer, modified for high temperature use, gave the composition data by a procedure essentially like that of Clerc, Hood and O'Neal.[5] This procedure and others used in this work are reported in more detail in an earlier paper.[5] Table 2 gives the analyses of the six waxes by hydrocarbon type. Figure 3 shows the distribution of the normal and branched paraffins by the number of carbon atoms. The data show that there may be considerable variation in the composition of waxes. While normal paraffins make up the bulk of all the waxes the quantity of non-normals in some cases (Waxes *A* and *F*) is surprisingly large.

The distributions shown in Figure 3 indicates that the non-normals are concentrated in the higher molecular weight portions of the waxes. The

TABLE 3
Mass Analyses of Wax Fractions

Overhead Fraction	40–45 Percent	60–65 Percent	85–90 Percent	6.9 Residue
WAX A				
Normal Paraffins	95.7	82.4	52.1	37.6
Branched Paraffins	4.2	13.9	28.6	25.9
Monocycloparaffins	0.1	3.6	17.7	30.5
Polycycloparaffins	0.0	0.0	1.3	4.4
Monocyclic aromatics	0.0	0.1	0.3	1.4
Aromatic cycloparaffins	0.0	0.0	0.0	0.2
Overhead Fraction	20–25 Percent	60–65 Percent	85–90 Percent	5 Percent Residue
WAX C				
Normal Paraffins	95.7	85.0	71.0	57.5
Branched Paraffins	3.7	11.0	18.4	21.8
Monocycloparaffins	0.6	3.6	9.8	17.7
Polycycloparaffins	0.0	0.4	0.8	2.5
Monocyclic aromatics	0.0	0.0	Trace	0.4
Aromatic cycloparaffins	0.0	0.0	0.0	0.1
WAX D				
Normal Paraffins	91.4	78.7	60.6	37.3
Branched Paraffins	7.5	16.0	24.0	34.0
Monocycloparaffins	1.1	5.0	14.0	23.8
Polycycloparaffins	0.0	0.3	1.4	4.9
Monocyclic aromatics	0.0	0.0	Trace	Trace
Aromatic cycloparaffins	0.0	0.0	0.0	Trace
WAX E				
Normal Paraffins	94.5	79.2	64.4	48.1
Branched Paraffins	5.5	13.6	19.4	23.0
Monocycloparaffins	0.0	6.5	14.4	24.3
Polycycloparaffins	0.0	0.4	1.5	3.7
Monocyclic aromatics	0.0	0.3	0.2	0.8
Aromatic cycloparaffins	0.0	0.0	0.1	0.1
WAX F				
Normal Paraffins	78.6	54.6	42.8	44.6
Branched Paraffins	14.9	26.7	32.4	23.9
Monocycloparaffins	6.5	16.5	20.5	24.1
Polycycloparaffins	Trace	1.9	3.6	6.1
Monocyclic aromatics	Trace	0.2	0.6	1.0
Aromatic cycloparaffins	0.0	0.1	0.1	0.3

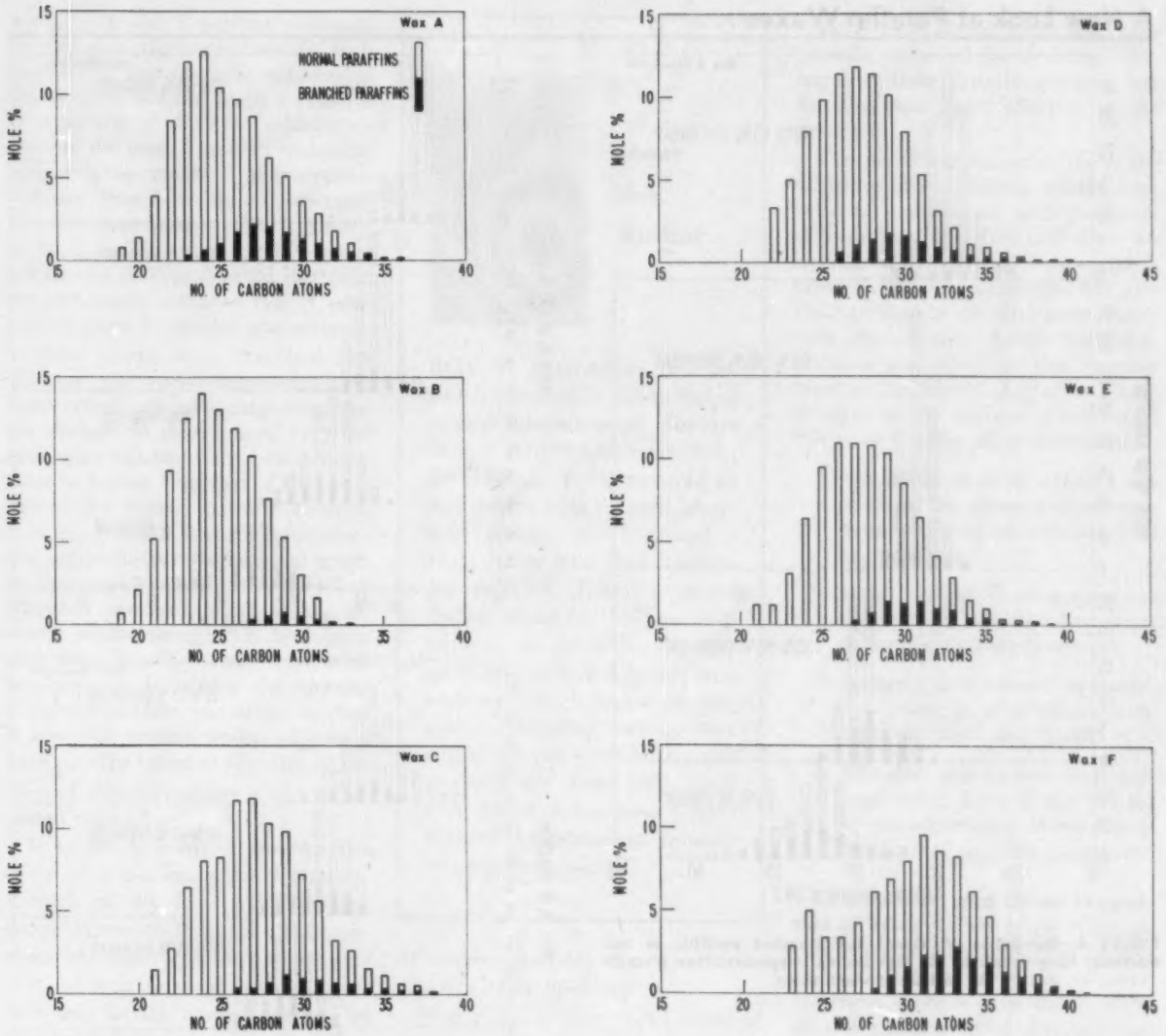


FIGURE 3—Distribution of normal and branched paraffins in six waxes: Quantity of non-normals in Waxes A and F is surprisingly large.

data also show that the proportion of non-normals increases with melting point of the wax, if Wax *A* is not considered. This wax was manufactured by de-oiling a blend of a low melting distillate wax with foots from the refining of a high melting wax and does not properly belong in such a comparison. Both of these trends in composition were predicted in the earlier analysis of Figure 2.

Mass analysis of selected distillation fractions gives a clearer picture of distribution of components by molecular weight than can be obtained from analysis of the whole wax. Table 3 shows the results of the analyses of selected fractions of waxes *A, C, D, E,* and *F*. Figure 4 shows the distribution of normal and branched paraffins in waxes *A, D* and *F*. These results confirm the distribution shown in the analyses of the whole waxes but give more details on the high-boiling components. Data on the residual fractions show the presence of small quantities of relatively high molecular weight non-normals that escaped the mass spectrometer's eye when diluted in the whole waxes. While the quantity of any one component of this type is quite small, they may, in the aggregate, exert an important effect on wax properties.

A feature of the analyses is the almost complete absence of aromatics. Comparison of the melting points of aromatics with those of other hydrocarbon types does not suggest this. It seems probable that solvent refining which preceded dewaxing removed most of these hydrocarbons. It is also quite possible that the ketones used in solvent dewaxing also act as selective solvents, retaining aromatic compounds in solution.

These waxes should be considered in two groups. The two low melting products, *A* and *B*, show very great differences in composition. This was expected since *A* came from a simple distillate while *B* came from the blend of a distillate and foots from a high melting wax cited before. This is also

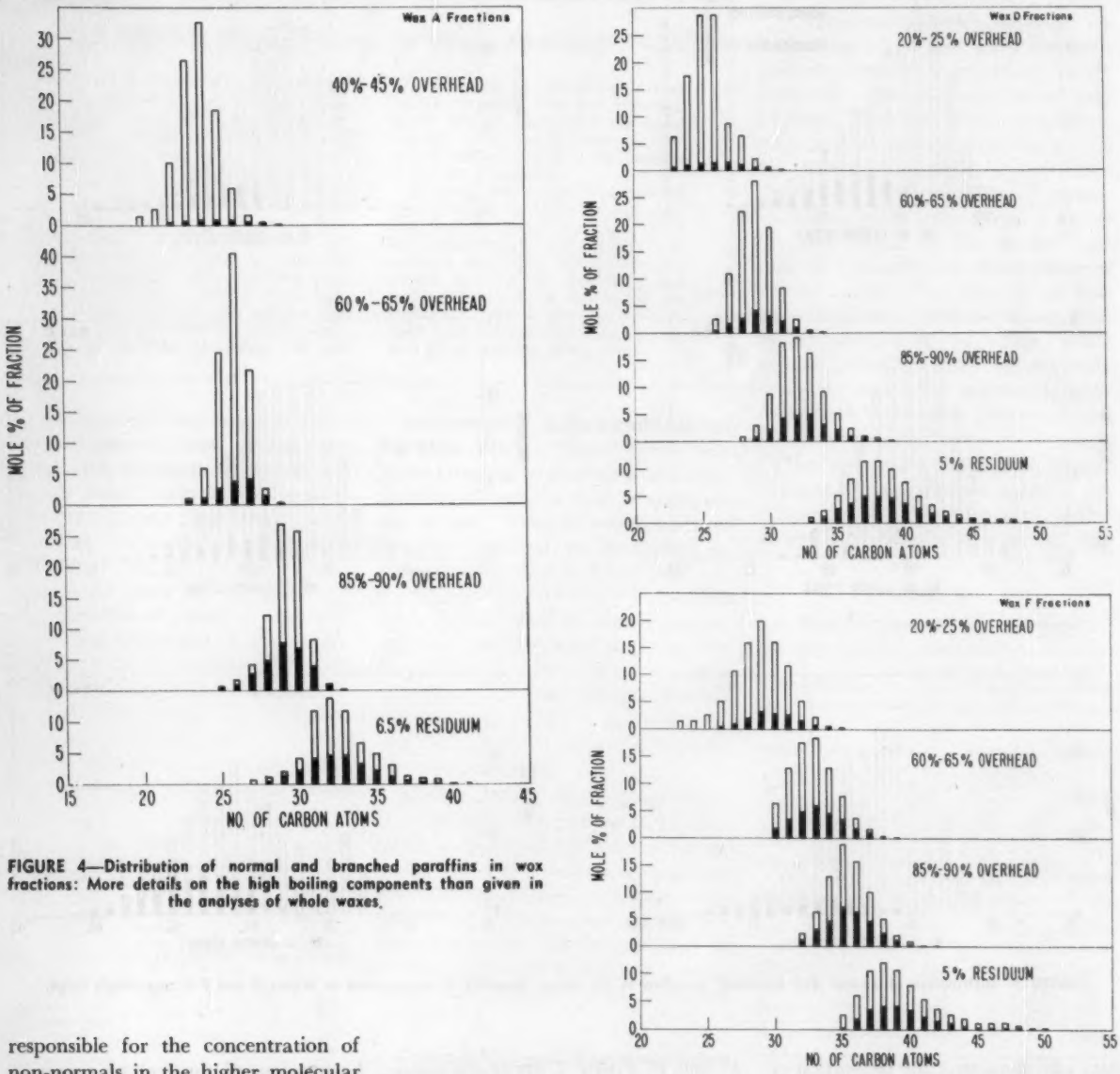


FIGURE 4—Distribution of normal and branched paraffins in wax fractions: More details on the high boiling components than given in the analyses of whole waxes.

responsible for the concentration of non-normals in the higher molecular weight fractions of Wax *A* to a greater extent than in any of the other waxes. The analysis of the original waxes *C*, *D*, and *E* show only small differences in non-normal content. However, the analyses of the fractions indicate that their non-normal content increases in the order *C*, *E*, *D*. Wax *D* also has a higher ratio of branched to cycloparaffins than the other two. Wax *E* has the highest non-normal content of all and these are more uniformly distributed throughout the whole molecular weight range than in any other case.

Composition and Tensile Strength—The data of Table 1 on waxes *A* and *B* show the most dramatic effect of composition on tensile strength. In service, *A* proved to be an excellent coating for milk containers while *B* was totally unsatisfactory. While other factors, certainly, played a part in this difference in performance, tensile strength was probably of great importance. Part of the difficulty with Wax *B* appeared to be due to its relatively high oil content. Both waxes were drastically de-oiled. The "oil" removed was a soft, semi-solid wax in both cases and included much material not classified as oil by the ASTM Method D 721-55T. De-oiling increased the tensile strength of both waxes but maintained advantage of *A*, although the difference between the two waxes decreased.

It is evident that the presence of substantial quantities of non-normal hydrocarbons is essential if we are to have maximum tensile strength in waxes of this melting range. It was impossible to bring the tensile strength of Wax *B* up to that of Wax *A* without the addition of non-normal hydrocarbons in the form of microcrystalline wax. The 95 percent distillation overhead, from Wax *A*, after deoiling had an appreciably lower tensile strength than the de-oiled original

wax. Since the 5 percent residuum contained a disproportionately high quantity of non-normals, omission of this fraction was essentially a removal of a portion of the non-normal contents of the wax. The high molecular weight non-normals of microcrystalline wax seem to be appreciably more effective than those naturally present in Wax *A*. Three percent microcrystalline wax in Wax *B* raised its tensile strength nearly to that of Wax *A*, containing about 25 percent non-normals.

These results show that both the quantity and type of non-normals are important in attaining maximum tensile strength in these waxes. First the molecular weight of the non-normals must be higher than that of the average of the normal paraffin content. It seems probable that the most effective materials must be hard and tough at the test temperature. The softer materials removed by de-oiling, reduced tensile strength. It is definite that there is an optimum content of non-normals. Increasing the amount of microcrystalline wax added to Wax *B* above 7 percent reduced tensile strength. The effect of excessive quantities of microcrystalline wax was reported earlier.[4]

It is not so easy to estimate the effect of non-normals on the tensile strength of the four high melting waxes. Waxes *C*, *D* and *E* all contain about the same quantity, 13-18 percent, of non-normal hydrocarbons. This may be the normal quantity to be expected in waxes of this melting range since the separation of the hydrocarbon types becomes more difficult with increasing molecular weight. It is also possible that this content of non-normals is close to the optimum for maximum tensile strength. The three de-oiled waxes showed little difference in this quality and the addition of microcrystalline wax to Wax *E* did not increase tensile strength above that obtained by de-oiling. In the case of low-melting Wax *B*, with a lower non-normal content, addition of microcrystalline wax was more effective than de-oiling.

Meet the Author

ROY T. EDWARDS is a research associate in the technical service laboratory of Socony Mobil Oil Company, Inc., Brooklyn, N. Y. He received an A.B. degree from Western Maryland College in 1931, and a Ph.D., from New York University in 1936. Edwards joined Socony Mobil in 1937, and was engaged in research, development, and technical service on a wide variety of petroleum specialties including waxes, wax emulsions, rust preventives, and aromatic oils. Since 1951, however, his work has been largely devoted to fundamental research on petroleum waxes.

Wax *F* has a quite high content of non-normal hydrocarbons and these are distributed throughout the molecular weight range to a much greater extent than in any of the other waxes studied. The tensile strength of this wax is low. Although this was improved by de-oiling it could not be brought up to that of the other high melting waxes by this means. The non-normal content appears to be above the optimum for this wax. The wide distribution through the molecular weight range also appears to have an adverse effect. Both this wax and Wax *E* contained some soft non-normals, removed by de-oiling, that impaired their tensile strength, but de-oiling was more effective in the case of *E*.

The preceding discussion shows the difficulty in establishing relationships between composition and properties of paraffin waxes. Not only must we consider the types of hydrocarbons present and their quantities but also their probable physical state. Since their physical state changes with temperature the effect of this variable must be considered. As far as tensile strength at 70 degrees is concerned this work justifies these conclusions.

1. Maximum tensile strength depends on the presence of an optimum content of non-normal hydrocarbons.
2. It is impossible, at present, to differentiate between the effects of various hydrocarbon types.
3. Effective non-normal hydrocarbons must, in combination be relatively hard and tough.
4. Effective non-normal hydrocarbons must have a molecular weight appreciably above that of the normal paraffin component.

Composition and Other Properties of Wax—There is less in formation available on the effect of composition on other properties of wax. However, there is little doubt about the effect of non-normal hydrocarbons here. Table 4 lists certain properties of the four high melting waxes. These will be discussed in turn. All of these measurements except hardness were made on wet waxed paper sheets with approximately 15 pounds of wax per ream.

Gloss—There is little to say concerning the effect of composition other than that an excess of non-normal hydrocarbons reduces gloss. The poor result with Wax *F* is an example of this.

Hardness—An earlier section pointed out that normal paraffins and perhaps other hydrocarbon types, form a soft, plastic crystal above the transition point and a hard crystal below this temperature. The consistency of a wax at lower temperatures will depend on the relative propor-

TABLE 4—Properties of High Melting Waxes

WAX	GLOSS		Hardness Abraham, @ 105 °F.	Blocking Temperature, °F.	WATER VAPOR TRANSMISSION GM/24 HRS./100 SQ. IN.		
	Initial	Retention			Flat	Creased	Scuff
C	Ok	Fair	17.8	107	0.36	2.53	13.5
D	Ok	Fair	21.1	104	0.68	3.22	15.5
E	Ok	Ok	26.2	108	0.38	2.77	17.5
F	Fair	Poor	27.1	120	0.20	2.84	23.5

tions of these two forms. At higher temperatures the melting of some components becomes important and if the amount of liquid becomes large the wax may soften sharply over a small temperature range. The measurements reported were made with an Abraham consistometer. The value listed is the cube root of the force in grams required to push a plunger with a circular face of 1 sq. cm. through the wax at a rate of 1 cm./min. At the test temperature of 105 F. the proportion of wax in the soft high temperature form probably controls the hardness values. Hardness can be related roughly to melting point. Wax *E* is a little higher melting than *C* and *D* and is somewhat harder. Wax *F* loses most of its advantage of high melting point because of its high non-normal content which appears to soften at a low temperature. However, enough of the components remain in the hard low temperature form at 105 F. to make it the hardest of the tested waxes.

Blocking—Blocking refers to the tendency of waxed paper sheets to stick to one another. It depends on temperature, time and pressure. These particular data were obtained on waxed paper sheets under a pressure of 0.28 pounds per square inch for seven hours at successively higher temperatures. Blocking results from development of a single crystalline mass connecting the two sheets in place of separate crystalline coatings on each sheet. The only way this can happen in reasonable time is through intervention of the liquid state. At least small portions of the wax coatings on the two sheets must liquefy, interdiffuse and resolidify to establish a bond.

In the case of the four waxes of Table 4 blocking temperature is closely related to melting point, indicating that none of these contain abnormal amounts of low melting components. The soft non-normal fraction of Wax *F* appears to remain in this state over a wide temperature range and not to liquefy at an unusually low temperature.

Turner, Brown and Harrison[18] relate hardness and blocking to the presence of low melting tails in waxes and the peakedness of molecular weight distribution. There can be little question that these two factors affect the distribution of wax components between the liquid and the two solid states. Low melting tails will change to the soft crystalline form and melt at lower temperatures than the bulk of the wax. This will tend to soften a wax and lower the blocking temperature. A wide molecular weight range gives a wax a broad melting point range and an even broader transition range. With such a product changes of state show their effect at lower temperatures. Broadening this range also increases the spread between transition point and melting point so that the effect of transition shows up at lower temperatures.

Water Vapor Transmission—These data were obtained by TAPPI Method T 448 M-49. Of the four products, Wax *D* showed abnormally poor resistance to the passage of water vapor with both flat and creased sheets. This is undoubtedly related to the composition of the wax but the available data do not suggest how. The physical state of the components is probably more important than their classification by chemical type in this case. Wax *E* showed unusually good resistance to passage of water vapor on flat sheets. This is due to its high non-normal content which is probably largely microcrystalline and fills voids between crystals. However, this portion is brittle enough to break on bending and the wax loses its advantage when the sheets are creased.

Scuff Resistance—The data reported are the forces necessary to drag a block of wax over a sheet of paper coated with the same wax. Other tests of this property measure the amount of wax removed on dragging a waxed paper sheet over a roughened metal surface or vice versa. These tests are designed to evaluate the tendency of a wax to build up on the rails and other parts of automatic packaging equipment.

Of those tested, Wax *F* is obviously far the worst. This particular wax attracted attention because of its high blocking temperature, and good resistance to water vapor transmission. However it failed miserably in a service test due to build up of wax on automatic packaging machinery. The high content of soft non-normals is probably the cause of this difficulty. Wax *E* shows hints of the same effect. A small portion of its non-normal content was found to be quite soft.

Composition Control in Wax Refining—There is no doubt that composition control in the manufacture of wax will become more important as consumer demands become more exacting. This cannot, of course, go far enough to limit production or increase costs unduly. New requirements can usually be met by suitable blends of available crude wax streams or of refined products combined with careful control of processing. The choice between available methods must usually be made on the basis of economics. One important difficulty is the incompatibility between certain requirements. For example, it may be possible to meet requirements for low temperature flexibility and moisture vapor transmissions only at the expense of increased rub-off of wax from treated paper or board. Here, and also in other places, the use of additives may be advantageous.

Work such as that reported here is still in its infancy. Its object is first to establish the contribution of various components to wax properties. The next step is location of both desirable and undesirable components in crude waxes to act as a guide in refining.

ACKNOWLEDGMENTS

F. P. Hochgesang and his associates, of the Socony Mobil Research and Development Laboratories, Paulsboro, N. J., were responsible for the mass spectrometer data. F. W. Littler and D. V. Finnelly obtained most of the other data reported.

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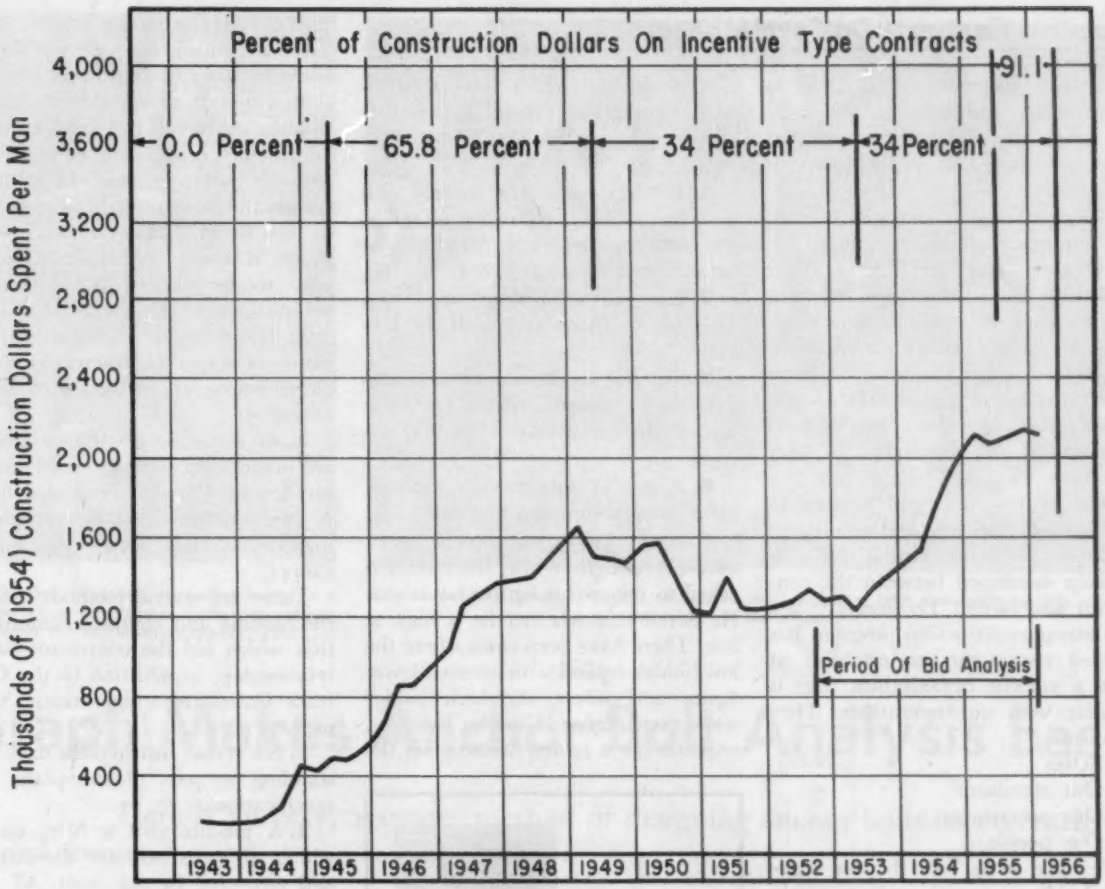

Two Year Moving Average – Capital Expenditures Per Construction Personnel (Journeymen And First Tier Foreman)

Incentive Contracts Do Save Money!

This is the method used by one large petrochemical plant to control construction costs. Twelve years of experience show the best efficiency with lump sum contracts.

J. E. Ross
The Dow Chemical Company
Freeport, Texas

THE FIRST construction work on Dow's Texas Division began in 1939, and was done on a cost-plus fee basis by a single contractor. Other contractors were brought in about 1944. Some work was done on an incentive basis beginning in 1945.

Many excellent engineer-constructor forms can and have presented good arguments for non-incentive contracts. For Dow's conditions, superior results have been obtained using incentive contracts, particularly in controlling costs.

All work that can be defined or is worth defining is done on incentive contracts. Where there are unknown conditions or the cost of defining is more than the expected saving a cost-plus contract is still used.

The system is quite simple—detailed plans are prepared along with their necessary specifications, bids are taken, approporiation requests are made based on the sum of the bids, our own costs, and contingency allowance. If the cost of preparing the

plans and specifications is large, a preliminary authorization for that cost, plus the cost of material that must be ordered to avoid delays, is requested.

The plans and specifications issued for competitive bidding must be detailed, clear, and complete. In so far as possible, use standard specifications and sketches of repetitive details are used. Accurately worded specifications are a must, particularly where tieins to existing operating plants are involved. This keeps shutdowns as short as possible—lost production is very expensive.

One of the principal factors in keeping job costs low and quality up to the required standard is the relationship developed between the contractor and owner. The more or less continuous construction program has enabled contractors to establish at least a nucleus organization that is familiar with our operations. They know our . . .

- Setup
- Our standards
- Our procedures
- Our people

We have some 7 or 8 firms regularly bidding general contract work. They in turn have over 50 subcontractors. When a job out of the ordinary arises, such as an office building, we go out to companies specializing in building construction. We also contract dirt work, pipe line installations, painting and similar work directly.

To justify even the preliminary authorization we make an estimate of the total cost as a basis for economic evaluation of the project. Later, at the same time the contractors submit their bids, our estimating group submits its estimate of the cost, based on the same site visit, drawings, and specifications. This estimate is used to check on the bids. If our estimate is much lower than the bids, we look for misunderstandings on the scope of the work, too much risk money in the bids, or a misinterpretation of some sort.

All bids are opened by the Contract Committee. It has six members, appointed by the general manager. The Legal, Purchasing, Construction, Operating and Engineering departments are represented. This committee has established over the years several policies which have contributed heavily to a good contractor-owner relationship. Some of these policies are:

1. Bid openings are private. All bids are kept in confidence so far as the owner is concerned. Any bid may be accepted or all rejected.

2. Late bids are refused, or all bids are held to be opened with the late bid.

3. No one is allowed to bid who will not be awarded the bid if he is low, if the conditions of the bid are equal.

4. A list of subcontractors to be used must accompany the bid.

5. If any bid appears to be either excessively high or low, the bidder is asked to review his figures for errors. He is not told whether he is high or low. There have been cases where the low bidder replied with an even lower figure and where the high bidder went even higher. Usually, however, requests for a review accomplish the purpose—they eliminate chance of an error of omission which we do not want to use to our advantage.

6. There is no established list of bidders. Although the same group of contractors may, as a general rule, bid over and over again, the Contract Committee may omit or add bidders as they see fit. If a contractor's supervision is being spread too thin, he may not be allowed to bid until he completes some projects.

7. The financial and performance rating of a new contractor is investigated before an invitation to bid is extended.

8. At least two cost-plus contracts are maintained with general contractors for work that cannot be defined. A performance competition can be maintained even if cost competition cannot.

There are several methods used in the bidding and contract administration which aid the contractor-owner relationship, in addition to the Contract Committee's operations. Some of them are:

1. No verbal instructions have any standing as part of the plans and specifications.

2. A job-site visit is held, during which all questions are directed to and answered by one man. All bidders make the same site visit. Changes are confirmed by addendum drawings or specifications.

3. Extras are checked for scope by the field (inspecting) engineer and for price by estimators in the Engineering department. Extras are covered by written change orders.

4. Although at various stages of the project three different people may represent the owner, there is only one at any time. During the actual construction, for example, the field engineer is the owner's spokesman.

Results of this operation are quite satisfactory. Over-runs of authorizations have ceased. As the chart indicates, money has been saved. Quality is very acceptable, due in part to the "prospect" of future work held before the contractors. The time required for incentive work is not significantly different. It is felt that proper planning can save as much time as the early start allowed by non-incentive contracts.

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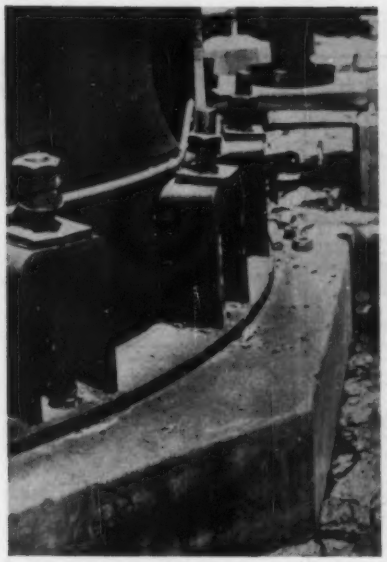
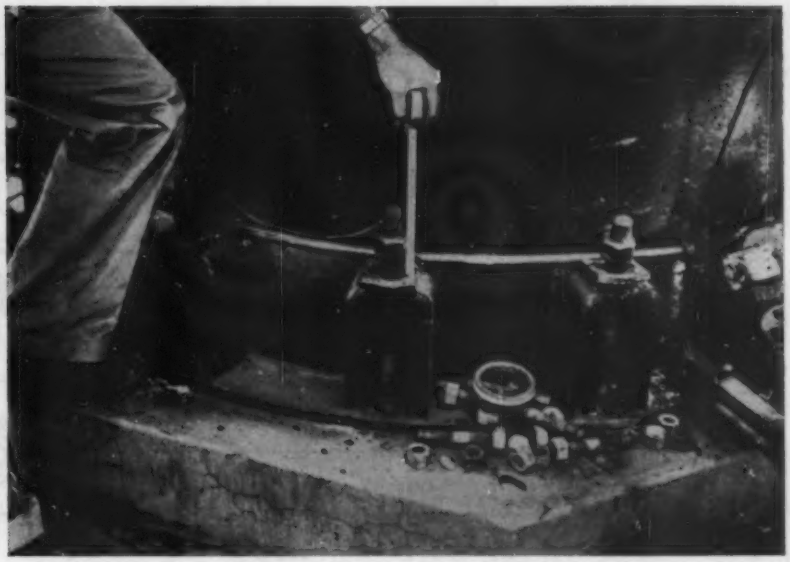
##

Meet the Author

J. E. ROSS graduated from the University of Texas in 1937 with a B.S. degree in mechanical engineering. Shortly after graduation he joined Reed Roller Bit Co. where he spent the next five years. He joined The Dow Chemical Co. as a mechanical design engineer and since that time has been group leader of the mechanical design squad, assistant to the engineering manager, assistant chief engineer in charge of the Project division, and in April of last year was promoted to his present position as chief engineer. He is a registered engineer in Texas, and a member of the American Society of Mechanical Engineers, and the Texas Society of Professional Engineers.



Here's what happened to anchor bolts on a column in a Bakersfield, California, refinery during the earthquake (July 21, 1952).



Bolts shown were deformed beyond the elastic limit and later tests demonstrated that ultimate strength was almost reached.

Graph Makes Anchor Bolt Analysis Easy

Here is an easy, accurate method of designing anchor bolts on eccentrically loaded towers.

Andrew A. Brown
U. S. Naval Station
New York

ANALYSIS OF ANCHOR BOLTS for tall, cylindrical towers is frequently complicated by eccentric loading such as off-center piping or heat exchangers. Hurricanes or earthquakes will increase these eccentric loads. The usual formula for computing anchor bolt stresses has been, $F = \frac{Mc}{I} - \frac{P}{A}$. Where F is the tension in the outermost bolt, and A is the total bolt area. This formula errs on the wrong side of safety unless the neutral axis is on the vessel diameter.

A quick, accurate solution of anchor bolt stresses, involving only a few computations, is afforded by the use of the graph shown in Figure 2.

HOW THE METHOD WORKS

Take this vessel for example:

$W = 118{,}000$ lbs. $\quad D = 77$ inches
$M = 8{,}640{,}000$ in. lbs. $\quad t_c = 5$ inches
$n = 12$

and there are eight 1¼-inch round anchor bolts.

$A_s = 8 \times 1.227$ and $A_sN = 8 \times .89$

Compute pn, e, and e/D as follows:

$$pn = \frac{12 \times 8 \times 1.227}{5 \times 77 \times \pi} = .097, \quad e = \frac{8{,}640{,}000}{118{,}000} = 73.2 \text{ inches}$$

$$e/D = \frac{73.2}{77} = .952$$

With these values, move vertically on the diagram at pn = .097 to the e/D value of .952, and then horizontally to the pn curves where pn = .097 and then vertically to get value of $C_s = 5.5$. Also continue horizontally to the k/1 — k curve and up to read $C_c = .41$. The value of k was found to be .29 by going horizontally to the right.

By substituting these values in the formula: $f_s' = \frac{Wn\,C_s}{Dt_c}$,

$$f_s' = \frac{118{,}000\ (12)\ 5.5}{77\ (5)} = 20{,}240 \text{ psi, and}$$

$$f_s = f_s' \times \frac{A_s}{A_sN} = (20{,}240)\ \frac{1.227}{.89} = 27{,}900 \text{ psi, also}$$

$$f_c = \frac{f_s'}{n} \times C_c\left[1 + \frac{t_c}{2\,KD}\right] = \frac{20{,}240}{12} \times .41\left[1 + \frac{5}{2\ (77)\ (.29)}\right]$$

$= 770$ psi. (tension in outermost bolt)

HOW THE CURVES WERE DEVELOPED

The usual assumptions are made that relate to the behavior of reinforced concrete beams and the symbols are those found in concrete design books.

f_c = unit stress in concrete at the flange center
f_s = unit stress in steel

The assumption is made that the anchor bolt circle passes through the center of the flange at the equipment base.

To get the total force acting on the concrete:

Let dP_c = force acting on area $t_c r d\alpha = f_c' t_c r d\alpha$

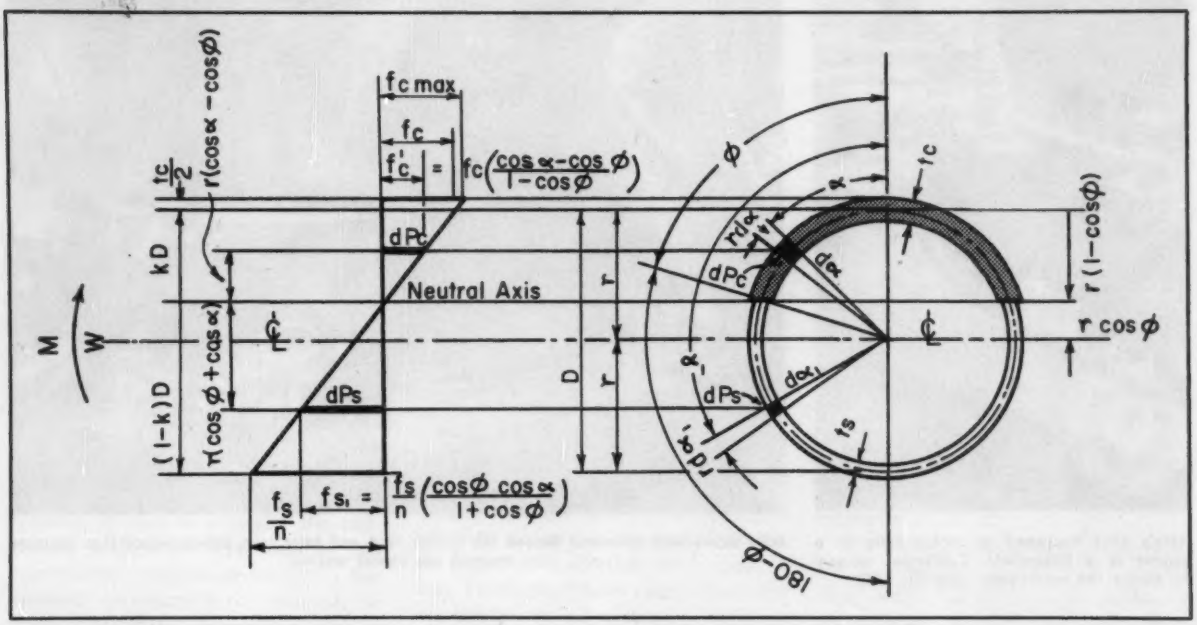


FIGURE 1—Scheme used for derivation of formulae.

where $f_c' = \frac{f_c(\cos\alpha - \cos\phi)}{1 - \cos\phi}$, then

$$dP_c = \frac{f_c t_c r(\cos\alpha - \cos\phi)d\alpha}{1 - \cos\phi}, \text{ and}$$

$$P_c = 2f_c r t_c \int_0^{\phi} \frac{(\cos\alpha - \cos\phi)d\alpha}{1 - \cos\phi} = \frac{2f_c r t_c}{1 - \cos\phi}\left[\sin\alpha - \cos\phi\,\alpha\right]_0^{\phi}$$

$$P_c = \frac{2f_c r t_c}{1 - \cos\phi}(\sin\phi - \phi\cos\phi) \qquad (1)$$

To get total moment of the force on the concrete about the neutral axis: $d\,M_c = dP_c[r(\cos\alpha - \cos\phi)]$ substitute the value of dP_c; then $M_c = \frac{2f_c r^2 t_c}{1 - \cos\phi}\int_0^{\phi}(\cos\alpha - \cos\phi)^2 d\alpha$

$$= \frac{2f_c r^2 t_c}{1 - \cos\phi}\left[\int_0^{\phi}\cos^2\alpha\,d\alpha - 2\cos\phi\int_0^{\phi}\cos\alpha\,d\alpha + \int_0^{\phi}\cos^2\phi\,d\alpha\right]$$

$$= \frac{2f_c r^2 t_c}{1 - \cos\phi}\left[\frac{\alpha}{2} + \frac{1}{2}\sin\alpha\cos\alpha - 2\cos\phi\sin\alpha + \cos^2\phi\,\alpha\right]_0^{\phi}$$

$$= \frac{2f_c r^2 t_c}{1 - \cos\phi}\left[\frac{\phi}{2} - \frac{3}{2}\sin\phi\cos\phi + \phi\cos^2\phi\right]$$

To get the moment of the forces acting on the concrete about the center of the base, add $P_c(r\cos\phi)$ to the above $= \frac{2f_c r t_c}{1 - \cos\phi}(\sin\phi - \phi\cos\phi)(r\cos\phi)$

$$S_o M_c' = \frac{2f_c r^2 t_c}{1 - \cos\phi}\left(\frac{\phi}{2} - \frac{1}{2}\sin\phi\cos\phi\right) \qquad (2)$$

TABLE 1

K	∅°	e/D=1.0 pn	e/D=.80 pn	e/D=.70 pn	e/D=.60 pn	e/D=.50	e/D=.45 pn	e/D=.40 pn	e/D=.35 pn	e/D=.30 pn	K/(1−K)
.00	00	....	....	....	....	....	....	....	....	....	.....
.05	25° 50′	.0042	....	....	....	....	....	....	....	....	.0527
.10	36° 52′	.0133	.008	.0070	.0040	....	....	....	....	....	.111
.15	45° 34′	.0273	.0202	.0153	.0098	....	....	....	....	....	.177
.20	53° 08′	.0470	.0353	.0272	.0175	.0043	....	....	....	....	.250
.25	60° 00′	.0742	.0537	.0430	.0291	.0110	....	....	....	....	.330
.30	66° 25′	.111	.0840	.0659	.0455	.0195	.0040	....	....	....	.428
.35	72° 32′	.160	.123	.0980	.0686	.0322	.0109	....	....	....	.538
.40	78° 26′	.226	.174	.1410	.1011	.0517	.0226	....	....	....	.666
.45	84° 16′	.315	.245	.199	.145	.0792	.0397	....	....	....	.818
.50	90° 00′	.437	.341	.281	.208	.121	.0680	.0092	....	....	1.00
.55	95° 44′	....	.477	.390	.298	.180	.1105	.0320	....	....	1.22
.60	101° 32′	....	....	.560	.430	.271	.177	.0720	....	....	1.50
.65	107° 28′	....	....	....	....	.413	.283	.1415	.0033	....	1.866
.70	113° 35′	....	....	....	....	.630	.455	.2570	.0325	....	2.33
.75	120° 00′	....	....	....	....	....	....	.4550	.1610	....	3.00
.80	126° 52′	....	....	....	....	....	....	....	.373	....	4.00
.85	134° 26′	....	....	....	....	....	....	....	.882	....	5.66
.90	143° 08′	....	....	....	....	....	....	....	....	.0598	9.00
.95	154° 10′	....	....	....	....	....	....	....	....	.3850	19.00
1.00	180° 00′	....	....	....	....	....	....	....	....	....	.....

$$pn = \frac{e/D(\sin\varnothing - \varnothing\cos\varnothing) - \frac{1}{4}(\varnothing - \sin\varnothing\cos\varnothing)}{\frac{e}{D}[(\pi - \varnothing)\cos\varnothing] + \frac{1}{4}[(\pi - \varnothing) + \sin\varnothing\cos\varnothing]}$$

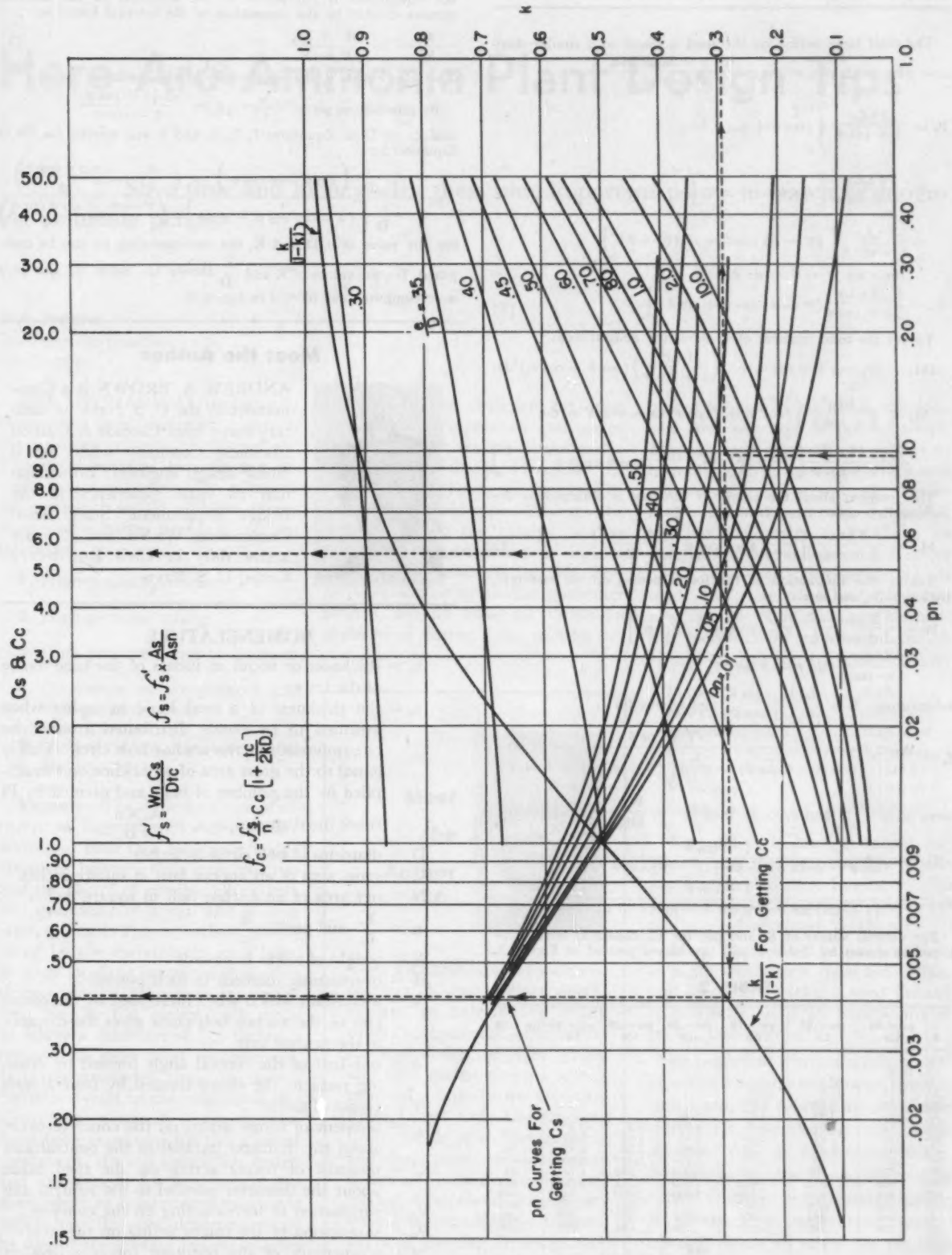


FIGURE 2—With these curves, you can find stresses in anchor bolts quickly.

Easy Anchor Bolt Analysis . . .

The total force acting on the steel is found in a similar manner: $dP_s = t_s f_s' r d\alpha_1 = f_s t_s r \frac{(\cos\phi + \cos\alpha_1)\,d\alpha_1}{1+\cos\phi}$

$$P_s = \frac{2\,t_s f_s r}{1+\cos\phi}\int_0^{\pi-\phi}(\cos\phi+\cos\alpha_1)\,d\alpha_1$$

$$= \frac{2\,t_s f_s r}{1+\cos\phi}\left[\cos\phi\,\alpha_1 + \sin\alpha_1\right]_0^{\pi-\phi}$$

$$= \frac{2\,t_s f_s r}{1+\cos\phi}\left[(\pi-\phi)\cos\phi + \sin(\pi-\phi)\right]$$

since $\sin(\pi-\phi) = \sin\phi$

$$P_s = \left[\frac{2\,t_s f_s r}{1+\cos\phi}(\pi-\phi)\cos\phi + \sin\phi\right] \qquad (3)$$

To get the total moment of f_s about the neutral axis:

$$dM_s = dP_s(\cos\phi+\cos\alpha_1)r = \left(\frac{f_s t_s r^2}{1+\cos\phi}\right)(\cos\phi+\cos\alpha_1)^2 d\alpha_1$$

$$M_s = \frac{2\,f_s t_s r^2}{1+\cos\phi}\int_0^{\pi-\phi}(\cos^2\phi + 2\cos\phi\cos\alpha_1 + \cos^2\alpha_1)\,d\alpha_1$$

$$= \frac{2\,f_s t_s r^2}{1+\cos\phi}\left[(\pi-\phi)\cos^2\phi + \frac{3}{2}\cos\phi\sin\phi + \frac{\pi-\phi}{2}\right]$$

The moment about the center of the base is obtained by deducting $P_s(r\cos\phi)$ from the above:

$$M_s' = \frac{2\,f_s t_s r^2}{1+\cos\phi}\left[\frac{1}{2}\sin\phi\cos\phi + \frac{\pi-\phi}{2}\right] \qquad (4)$$

Taking the summation of the forces acting on the concrete, anchor bolts, and tower

$$W + \frac{2\,t_s f_s r}{1+\cos\phi}\left[(\pi-\phi)\cos\phi + \sin\phi\right]$$

$$= \frac{2\,f_c t_c r}{1-\cos\phi}(\sin\phi - \phi\cos\phi)$$

substituting $f_c = \frac{f_s(1-\cos\phi)}{n(1+\cos\phi)}$ and solving for f_s

$$f_s = \frac{Wn}{2\,rt_c} \times \frac{1+\cos\phi}{(\sin\phi-\phi\cos\phi) - \frac{t_s}{t_c}\left[(\pi-\phi)\cos\phi+\sin\phi\right]}$$

since $pn = \frac{t_s}{t_c}$ and $2r = D$, then $f_s = \frac{Wn}{Dt_c} \times C_s$, where

$$C_s = \frac{1+\cos\phi}{(\sin\phi-\phi\cos\phi) - pn\,[(\pi-\phi)\cos\phi+\sin\phi]}$$

or $$C_s = \frac{1+\cos\phi}{(1-pn)\sin\phi - \phi\cos\phi - pn\,(\pi-\phi)\cos\phi}$$

For various values of K and pn, the C_s constants were computed as shown by Table 2 and the curves plotted in Figure 2.

TABLE 2

K	pn=.01 Cs	pn=.05 Cs	pn=.10 Cs	pn=.20 Cs	pn=.30 Cs	pn=.40 Cs	pn=.50 Cs
.05	.....	.....	.....	.....	.....	.....	.....
.10	31.0	.....	.....	.....	.....	.....	.....
.15	12.7	43.7	.....	.....	.....	.....	.....
.20	7.17	11.6	51.8	.....	.....	.....	.....
.25	4.64	6.02	9.90	....	.....	.....	.....
.30	3.21	3.82	4.97	12.65	.....	.....	.....
.35	2.33	2.61	3.07	4.80	10.9	48.5	.....
.40	1.70	1.87	2.09	2.73	3.92	6.97	30.9
.45	1.31	1.39	1.50	1.84	2.20	2.92	4.50
.50	1.01	1.05	1.10	1.25	1.43	1.66	2.00
.55	.778	.802	.837	.905	.992	1.12	1.22
.60	.603	.615	.632	.670	.713	.760	.813
.65	.464	.472	.489	.500	.520	.543	.568
.70	.352	.358	.360	.371	.381	.393	.403
.75	.262	.264	.266	.272	.277	.283	.289
.80	.189	.189	.190	.193	.194	.198	.200
.85	.....	.....	.....	.....	.....	.....	.....
.28	.....	.....	.....	30.8	.....	.....	.....
.33	.....	.....	.....	.....	28.7	.....	.....

$$C_s = \frac{1+\cos\varnothing}{(1-pn)\sin\varnothing - \varnothing\cos\varnothing - pn(\pi-\varnothing)\cos\varnothing}$$

The total external moments divided by the total weight of the equipment is equivalent to the moments of the internal stresses divided by the summation of the internal forces or

$$\frac{M}{W} = \frac{M_c' + M_s'}{P_c - P_s} \qquad (5)$$

This also equals e, the eccentricity of the resultant forces.

By substituting $pn = \frac{t_s}{t_c}$, $f_s = \frac{nf_c(1+\cos\phi)}{1-\cos\phi}$ and $2r = D$ in Equations 1, 2, 3, and 4 and solving for Pn in Equation 5:

$$pn = \frac{\frac{e}{D}\left(\sin\phi - \phi\cos\phi\right) - \left(\frac{\phi}{4} - \frac{\sin\phi\cos\phi}{4}\right)}{\frac{e}{D}\left[(\pi-\phi)\cos\phi + \sin\phi\right] + \left(\frac{\pi-\phi}{4} + \frac{\sin\phi\cos\phi}{4}\right)}$$

for any value of e/D and K, the corresponding pn can be computed. For the values of K and $\frac{E}{D}$ shown in Table 1, the pn's were computed and plotted in Figure 2.

Meet the Author

ANDREW A. BROWN is a Commander in the U. S. Navy on military leave from Carbide & Carbon Chemical Company where he is senior design engineer. Brown has had 10 years experience in the Bridge department, State Road Commission, W. Va. and 12 years active duty in Civil Engineers Corps, U. S. Navy.

NOMENCLATURE

t_c = thickness or width in inches of the base flange of the tower

t_s = the thickness of a steel band in inches when assumed to be evenly distributed around the circumference of the anchor bolt circle. This is equal to the gross area of an anchor bolt multiplied by the number of bolts and divided by Pi times the diameter, or $t_s = \frac{A_s N\,n}{\pi D}$.

D = diameter of bolt circle in inches

A_s = gross area of an anchor bolt in square inches

$A_s N$ = net area of an anchor bolt in square inches

$n = \frac{E_s}{E_c}$ and $pn = \frac{t_s}{t_c}$

W = weight of tower in pounds

M = overturning moment in inch pounds

k = a constant which when multiplied by the diameter of the anchor bolt circle gives the distance to the neutral axis

ϕ = one-half of the central angle formed by drawing radii to the chord formed by neutral axis

r = radius of circle

M_c' = moment of forces acting on the concrete taken about the diameter parallel to the neutral axis

M_s' = moment of forces acting on the steel taken about the diameter parallel to the neutral axis

P_c = summation of forces acting on the concrete

P_s = summation of the forces acting on the steel

e = eccentricity of the resultant forces acting on the tower $= \frac{M}{W}$

##

Here Are Ammonia Plant Design Tips

Save time and money with these nine important points to watch in designing ammonia plants.

C. E. Freese
The Fluor Corporation, Ltd.
Los Angeles

THE MECHANICAL problems in connection with ammonia plants is the primary concern of this article. The items outlined here do not involve secret processing or patented designs which would prohibit discussion and consists primarily of the following:

1. High-pressure vessels
2. High-pressure tubing
3. High-pressure flange connections
4. Comments on compressors and high-pressure valves
5. Comments on liquid-air plant and equipment

Vessels—The American manufacturers of high-pressure vessels have arrived at their own design methods.[1] However, between their individualism and the choice of possible alloys, correct evaluation of design and price is often difficult. This is further complicated by the variation in state laws. In some localities ammonia separators designed for 10,000 pounds per square inch may be 6⅝ inches thick while in others a thickness of 7⅞ inches is required to meet legal requirements. It is recommended that the manufacturer should be the responsible designer until standards of construction have been developed for this class of equipment. He will submit his design and calculations for approval. For areas where no legal control exists, it is well to have the vessel design approved by one of the leading insurance firms to make certain it is insurable in service.

Although vessels for ammonia service have to be designed for high pressure, the temperature and corrosion problems are minor. Ammonia converters are designed so that the vessel shell and heads are kept cool by the incoming cold gases, although the temperatures in the catalyst holders are in the neighborhood of 900 to 1000 F. The internals for this service vary according to the particular process, but all have the common problem of correct heat transfer required for controlling metal temperature and selection of proper alloys. Most of these internals are subject to nitriding and/or hydrogen attack and alloys are selected accordingly. Therefore, some parts are made from 18-8 stainless steel, some from 12 to 16 percent chrome and in critical zones 35-15 (reversed chrome-nickel) is used. The vessel shell and heads are usually made of an alloy steel containing molybdenum and vanadium. A typical analysis for a forged vessel is:

Carbon	0.45
Manganese	0.60-1.00
Phosphorus	0.04 max.
Sulfur	0.04 max.
Silicon	0.25-0.45
Vanadium	0.10-0.20
Molybdenum	0.30-0.60

No welding is done on forged vessels to these specifications. The vessels are heat-treated after forging to give an ultimate tensile around 85,000 psi and a yield of about 55,000 psi.

Alloys for welded construction, such as multilayer vessels, have less carbon and frequently nickel is used instead of molybdenum. They possess similar physical properties.

Regardless of whether a forged steel vessel or a welded multilayer vessel is purchased, the constructor may have difficulty maintaining his construction schedule due to fabrication delays. Sometimes trouble is encountered in forged vessels in heat-treating, making it necessary to reheat-treat several times in order to attain the required physical properties. This is a serious setback in schedule when it is realized that a forging weighing nearly 100,-

Meet the Author

C. E. FREESE has had wide experience in the product development of fabricated steel products, hydraulic equipment, machine design, pressure vessels and heat exchangers. As a mechanical consultant for the Fluor Corp., Ltd., Los Angeles, Calif., he is a staff consultant and deals with the mechanical design of pressure vessels and related equipment. Freese attended Western Reserve University and Evening Division, and Case Institute of Technology, both of Cleveland, Ohio.

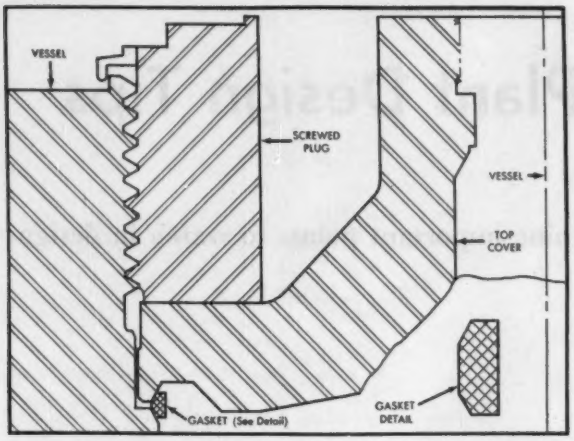


FIGURE 1—Double-cone-type of gasket closure using threaded plug.

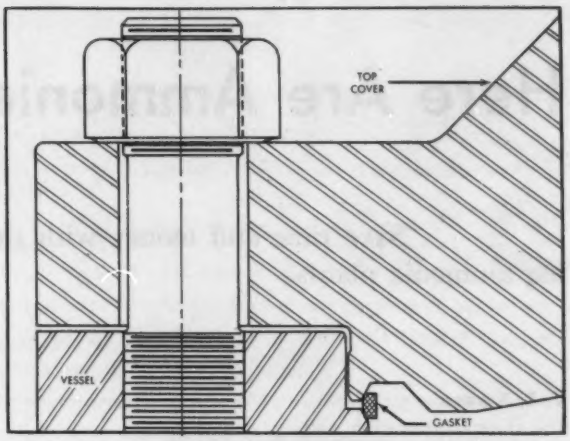


FIGURE 2—Double-cone-type gasket closure using large diameter studs.

000 pounds does not cool very fast.

Similar trouble can occur in the multilayer vessels but in this case delay is more apt to be caused by a defect in the forged-steel head which does not show up until after welding.

It is customary to build the high-pressure vessels used in ammonia manufacture with removable heads and several closure designs are available to the designer.

The three most accepted closures are:

1. The Bridgeman closure.
2. The Delta-gasket closure.
3. The double-cone-type gasket closure.

The Bridgeman closure and Delta-gasket closure are thoroughly described elsewhere.[2]

The double-cone type of gasket was originally designed in Europe and consists of a ring made so that it has two sealing faces machined at 30 degrees from the vertical which form part of the outer surface, Figure 1. The pressure acting on the ID of this gasket, which is made of aluminum for ammonia service, expands it into the gasket-sealing surfaces of shell and head. As deflection occurs under pressure, this gasket is expanded into place to maintain a seal. In the original design, the assembly was held in place by a large threaded plug. This arrangement is very satisfactory from the strength standpoint, but has been known to have thread damage occur. Even though a three-piece plug may be employed to overcome this trouble, it was decided to use large-diameter studs, as shown in Figure 2, on several jobs designed for 10,000 psi.

No change was made in the way the gasket contacted the vessel shell and head although a slight modification was used for some of the vessels in order to prevent excessive inward deflection if it became necessary to preload the bolts tighter than normal to overcome surface variation in gaskets or vessel. This modification, which is shown in Figure 3, consisted of providing a shoulder about 0.020 inch smaller than the gasket ID. In order to retain the pressure seal, necessary for the successful application of this gasket, a groove was cut in this shoulder for its entire circumference and holes provided to make certain that the pressure would act on the inside diameter of the gasket. The modified design has the effect of giving a more solid indication of contact when bolting.

Whereas, it is believed that this design will permit a seal even if the surfaces are not perfect, good workmanship in machining the gaskets is still of utmost importance. It was found that forged-aluminum gaskets which had slight tearing marks would not seal although they were softened by annealing. It should be pointed out, however, that these gaskets were apparently finished with a broad-face tool and the surface was not uniform. At the time of modifying the design, a groove also was cut in the gasket to reduce the contact area.

Since the gaskets were annealed before machining, it was difficult to obtain a surface which did not show slight tearing even though a sharp V-tool was used with kerosene lubrication. The fine serrations made by the sharp tool are acceptable if not too deep. One gasket used with this modification had a surface definitely inferior to another, but both sealed equally well with no additional bolt tightening required.

Experience with this design has resulted in very rigid manufacturing specifications. Units not employing the modification described are more critical in requiring a perfect gasket surface and uniform tightening of the bolts. It should be pointed out here that the threaded-plug design does assure uniform gasket loading with very little care on the part of the maintenance personnel, although gaskets have been broken due to shifting out of place during assembly. The bolted closure requires checking with feeler gages at four chosen points during tightening to maintain uniform gasket loading. This is easily done by pretightening with only four bolts and tightening the remainder after making certain that the head is properly aligned with the shell. The remaining bolts have to be tightened gradually and uniformly, the same as required of any bolted closure.

A discussion of the double-cone gasket is not complete without calling attention to the necessity of protecting the gasket surfaces of the shell and head from corrosion during shipment and before plant start-up. An attempt was made on one project to protect these surfaces with a plastic and place silica jell in the vessel. This idea is good if the vessel is hermetically sealed, but in this case the manufacturer provided a tempo-

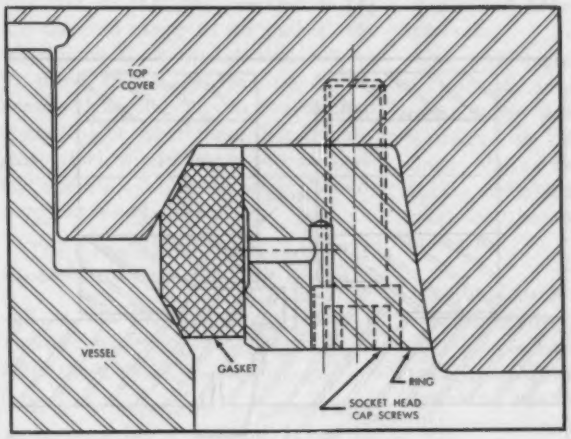


FIGURE 3—Double-cone-type gasket closure showing modification to insure proper positioning and application of pressure behind the gasket.

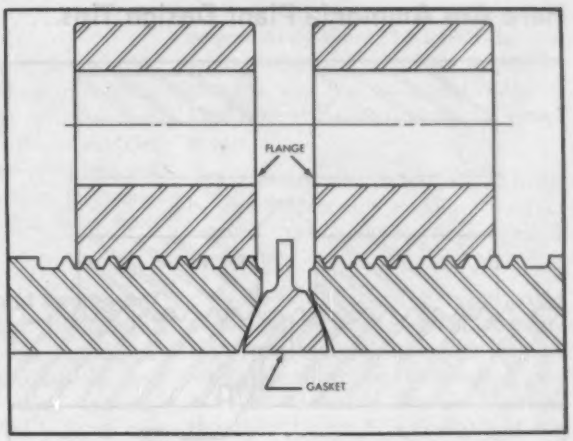


FIGURE 4—Flange connection showing lens-joint type of gasket.

rary gasket between the bolts and the outside rim of the flange. Moist air leaked into the vessel around the bolts due to atmospheric temperature changes. The plastic coating did not prevent corrosion under these conditions and it was necessary to reface the vessel gasket seat by lapping. The heads were cleaned up by machining.

Similar trouble was encountered in one converter which was not adequately protected after it was installed. As a result of this experience, new instructions specify that the vessels are to be shipped and stored with the aluminum gasket in place using a rust preventative grease on the surfaces to protect them.

Since it is imperative to avoid oil or grease as much as possible in operation, it is necessary to clean all surfaces before final assembly and lubricate with only a thin layer of grease.

The double-cone aluminum gasket has certain advantages which make it desirable to use:

- It is a pressure-sealing gasket requiring very little initial bolt loading.
- When properly handled it can be used over several times.
- It can be disassembled with ease.
- It is not necessary to retighten during operation if operating pressures drop below normal due to other difficulties.

Tubing—As pointed out under "Vessels," anhydrous ammonia is not corrosive to ordinary steel, and alloys are used primarily for strength. Most of the pipe for the ammonia synthesis section can be carbon steel with chrome-moly steel being used at the outlet side of the converters where the temperature is about 500 F. This is conservative since carbon steel is considered satisfactory for service at the temperature and hydrogen partial pressure[3] encountered in this service.

If a comparison is made with the tubing furnished for several units in this country with that specified by French practice, it will be discovered that the French employ less wall thickness for the same pressure. Further investigation will reveal that the French stress their material higher than American practice, but are more strict on manufacturing tolerances. It must be kept in mind that in Europe material is more important than the amount of labor involved. The opposite is true in this country. It is not difficult to obtain a mill tolerance in Europe of ± 5 percent wall thickness instead of our $\pm$ 10 percent for cold-drawn seamless tubing. Thin-down due to hot bending also must be taken into consideration.

Wall thickness for heavy-wall tubes is usually determined using the well-known Llamé formula. In addition to this, it is interesting to run checks based on the "total-stress" and "maximum-shear" methods, both of which are used to some extent in high-pressure-vessel design and very well outlined by Maccary and Fey.[1]

The final selection of carbon-steel tubing for several recent plants consisted of modifying the analysis of ASTM A-106-B pipe material to guarantee a yield point of 40,000 psi and an ultimate tensile of 70,000 psi. A similar modification was later approved by the ASME Boiler Code Committee under Case No. 1207, except this case permits higher carbon than the modification made for the ammonia plants.

Since the carbon-steel tubing used for this application operates at a temperature of only 375 F. (400 F. design temperature), the allowable stress was taken as 22,000 psi with a 0.05-inch corrosion allowance or about 20,000 psi on the inside surface if no corrosion is considered. Basically no corrosion will occur in service and the 20,000-psi stress is more factual. This allowable stress increase to 20,000 psi is very close to being in direct proportion to the increase in yield strength from 35,000 psi to 40,000 psi when comparing it with the allowable stress in Section 3 of *The Code for Pressure Piping*. The same allowable stress was used for the 2¼ chrome—½ molybdenum tubing which was ordered to a 40,000 minimum yield point. A similar comparison of allowable stress increase in proportion to increase in yield will show the 20,000 psi allowable stress in the case of the chrome-moly material to be on the conservative side. It is believed that these allowable stresses can be increased further when the following factors are taken into consideration:

1. The maximum hoop stress as calculated by the Llamé formula is the stress on the inside surface of the tube. This stress diminishes rapidly and will be found to be much lower on the outside surface and at intermediate points.

2. No openings are cut or stubbed

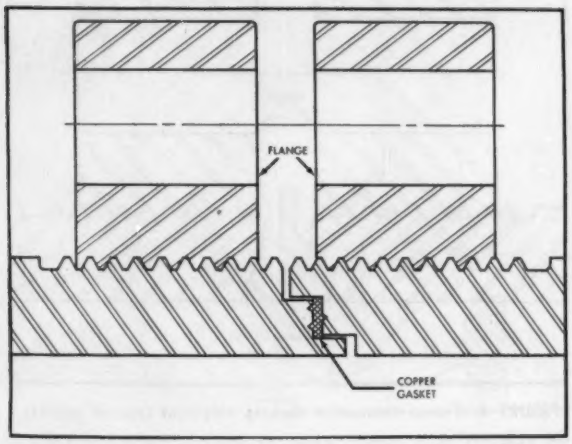


FIGURE 5—Flange connection showing retained copper-gasket joint.

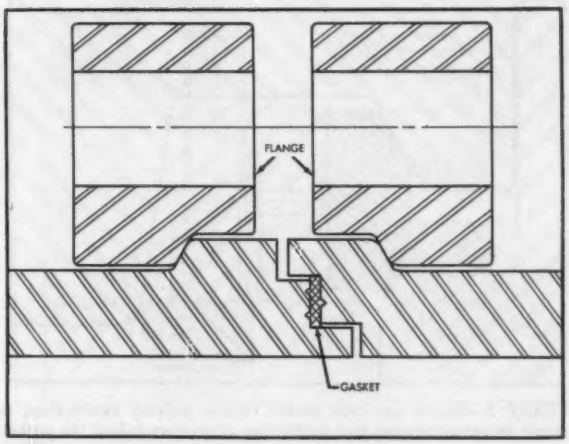


FIGURE 6—Modified lap joint showing tapered shoulder.

into the sides of these tubes.

3. When compared with the French practice, our allowable stresses are very conservative, since the French permit the maximum stress to get fairly close to the yield point.

In final design, the high-pressure tubing for the ammonia synthesis section was cold-finished on both OD and ID. The carbon steel and chomemoly were both heat-treated after cold-finishing. Tolerances were held to American standard mill tolerances for cold-finished tubes. No difficulty was encountered in fabrication.

It should be pointed out that on most sizes of this tubing, the wall thickness is sufficient to permit threading for attaching the screwed type of flange employed for this work. This extra metal was available to compensate for wall thinning when making hot-formed bends. Two smaller sizes which cannot be threaded have sufficient extra metal included for thin-down during bending.

Flange Connections—Two popular gasket designs are used in ammonia-plant construction, i.e., the lens-joint and the retained copper-gasket joint (Figures 4 and 5).

The lens-joint gasket consists of a solid steel disk with its faces machined to a spherical surface. It is a fairly thick gasket—being about ¼ inch thick at the outside edge and increasing to ½ to 1 inch thick at the bore, depending on the diameter and spherical radius. This gasket initially makes a line contact with the flange face which is usually machined to a 20-degree bevel. When bolted up this line contact becomes a band contact as the surfaces yield and examinations will show that the flange face is slightly indented. Some users reface or lap the flanges before reassembly to completely remove this indentation.

The retained copper-gasket joint is basically a double male and female joint. Annealed copper is used for the gasket. The gasket faces have one or two small V-grooves and the soft copper flows into these to help form a seal.

Perhaps the worst thing that has happened in this country regarding high-pressure flange connections is the fact that some manufacturers followed European practice and used 6-bolt flanges instead of bolts in multiples of four. Proper orientation of bolt holes is a serious problem when six bolts are used with weld-neck-type flanges. It is hoped that when we standardize on flanges for high-pressure that all six-bolt flanges will be eliminated.

The lens-joint gasket design is a good design, but it must be realized that it is often necessary to refinish the face after use by machining or lapping. Likewise, the gasket itself should be replaced after use or remachined to guarantee a seal. Many advocates of this design are of the opinion that it is capable of taking considerable misalignment. Investigation reveals that whereas some misalignment can be taken, trouble is apt to be encountered if it exceeds about 2 degrees. It is believed that if this design is used and misalignment is contemplated, the use of spherical washers under the bolts is indicated.

The retained copper-gasket also makes a very good joint. It is surprising the amount of abuse this joint will withstand and still seal under pressure.

Regardless of type of gasket and number of bolts employed, it is necessary to provide a suitable flange and bolting for the design chosen. Here again, American practice differs from the European practice. The recent plants from which information is used for this article had the high-pressure flanges designed to American procedure. Gasket-loading constants as published by the ASME Boiler Code and the allowable stresses permitted by the Codes were used. The flanges were screwed on the stub ends instead of using a shouldered lap joint type construction. An investigation was made of estimated stresses in the shouldered stub end design. This investigation revealed an over-stressed condition in a shoulder of conventional design, even though it was very much thicker and heavier than the usual lap-joint stub end. It is believed that one failure in service of this design was partly due to over stressing, although it was thought at the time to be the result of discontinuity stresses caused by undercutting at the radius adjacent to the hub. Since the failure mentioned happened a number of years ago, no attempt was made to go further into the matter. This overstressed condition can be overcome by tapering the

shoulder so that the reaction forces are directed closer to the gasket center, Figure 6. It should also be kept in mind that calculations of the smaller flanges may result in estimated stresses higher than those that actually exist which would account for successful operation of some square shouldered stub-ends in service.

The threaded flange has certain advantages over the lap-joint design.

1. It can be adjusted to obtain a variable space between flanges or to clear other parts.

2. It is removable by unscrewing without cutting or welding. It has the disadvantage of seizing on the thread if the stub-end thread has been damaged or dirt has not been removed. This trouble, when it occurs, is usually the result of careless handling and failure to wire brush before assembly.

Compressors and High-Pressure Valves—Compressor service for ammonia-plant work does not differ very much from any other high-pressure application. Compressors must be provided for air, nitrogen, natural gas, synthesis gas, and gas recirculation. Some of the compressors are used as mixed-service machines. Vibration dampeners are applied to reduce vibration to a minimum and the same problems regarding pipe-line hold-downs and supports exist that are encountered on other compressor installations.

High-pressure valves for this work are usually of a balanced or semi-balanced design. Most of them have a body consisting of a large forged-steel block machined to receive the valve parts. Some valves are designed by American manufacturers and some follow designs originating in Europe. Fluorocarbon-asbestos material is usually used for stuffing-box packing. Valves should be protected from atmospheric corrosion during the construction period and cleaned just prior to start-up. Packing glands should be tightened gradually during startup and no attempt should be made to seal glands at any other time. If a supply of dry nitrogen gas is available, valves can be cleaned earlier than start-up if the lines can be purged of air and dry nitrogen used for protection. This is not very practical over a long period of time unless the supply of gas can be replenished at proper intervals.

As with high-pressure flange connections and vessel closures, dirt is the worst enemy and every effort should be made to keep valve assemblies clean. Valves not properly protected during construction are in far worse condition than those that have been in service.

Liquid-Air Plant and Equipment—Most of the air-plant mechanical equipment consists of heat exchangers, packed columns for washing and scrubbing operations, filters and distillation columns. The bulk of this equipment operates at subzero temperatures requiring extensive use of austenitic stainless steel. Flanges present some difficulty owing to the low temperature, and welded connections are used wherever possible. The most common gaskets used are fluorocarbon-asbestos and the spirally wound type of metal gasket having an asbestos tape between the layers.

Where flanges are used, they are usually the lap-joint type. American practice requires both the lap-joint stub end and the lap-joint flange to be made from a suitable alloy to operate at low temperatures (refer to ASTM A-300 and A-320).

If the air plant is not furnished by an American firm, the flange material should be reviewed, because the American practice is not universal.

It is necessary to employ an air expander in air-plant design. Since the primary purpose of an expander is to dissipate energy, most installations employ either an electrical brake or an air brake. The expander has been used as the driver for a centrifugal compressor handling nitrogen. This sounds like an excellent idea and it is, once the unit is operating satisfactorily but this arrangement prevents other sections of the plant from being operated if it is necessary to make corrections or modify the expander.

Conclusions—

1. There is a definite need for an acceptable design standard similar to the ASME Unfired Pressure Vessel Code for the high-pressure class of vessels.

2. Until design standardization is realized, high-pressure-vessel design responsibility should be left to the vessel manufacturer who also should be charged with the responsibility of legal approval and evidence of insurability.

3. Construction schedules should be flexible enough to allow time to correct manufacturing difficulties if they arise.

4. The double-cone-type gasket closure can be recommended for many high-pressure applications and may be used with either the threaded plug or a bolted closure. The modification shown in Figure 3 is desirable if the bolted closure is used.

5. Allowable design stresses should be increased for thick wall, high-pressure tubing provided no openings are cut or stubbed into the sides.

6. High-pressure flange connections should have bolts in multiples of four, and regardless of gasket design used, they should follow ASME Code design.

7. More attention should be given to the protection of high-pressure valves during construction.

8. Air-plant equipment should be checked closely to make certain the proper alloys are used for the subzero temperatures encountered, and flanged joints should be held to the minimum.

9. Experience indicates that air expanders used in connection with air plants should dissipate the energy by the use of an electric brake or air brake instead of being relied upon as a driver for other process equipment.

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ACKNOWLEDGMENT

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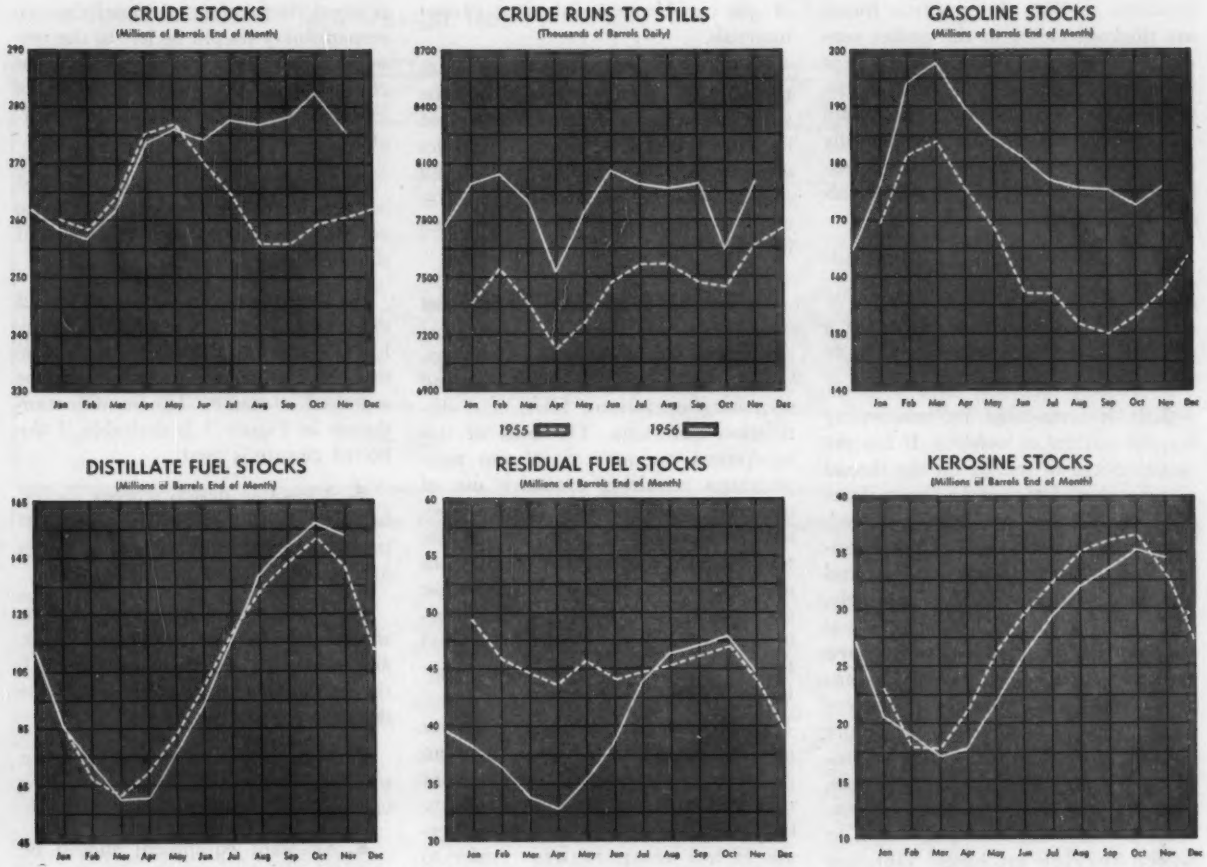

Taking Stock

Cecil W. Smith
Economics Editor

- **Refining rates at 5-month high**
- **Fuel oil stocks start to dip**
- **Crude stocks draining rapidly**

MONTH	CRUDE OIL			GASOLINE		KEROSINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1954:													
November	6,346	6,975	264,566	3,530	150,604	354	34,547	1,622	133,886	1,120	54,891	636	1,104
December	6,394	7,238	258,385	3,605	155,400	381	27,826	1,668	108,144	1,187	52,105	729	1,301
1955:													
January	6,761	7,379	260,156	3,639	169,562	409	23,266	1,740	86,692	1,235	49,457	739	1,348
February	6,835	7,549	258,630	3,655	181,643	374	18,291	1,847	68,513	1,239	46,042	751	1,379
March	6,886	7,374	264,430	3,543	183,972	357	18,187	1,703	62,457	1,185	44,970	742	1,319
April	6,887	7,136	275,232	3,502	175,601	312	21,486	1,534	70,139	1,110	43,838	697	1,123
May	6,677	7,281	276,948	3,605	168,751	296	26,375	1,519	83,559	1,111	45,083	742	1,137
June	6,613	7,484	270,850	3,725	157,439	269	29,830	1,628	100,652	1,080	44,398	764	1,159
July	6,632	7,580	264,601	3,824	157,079	286	32,749	1,575	119,169	1,091	44,894	860	1,161
August	6,665	7,580	256,427	3,858	151,912	290	35,292	1,621	133,675	1,090	45,480	756	1,155
September	6,731	7,483	256,269	3,784	150,194	279	36,361	1,621	143,248	1,061	46,267	829	1,218
October	6,837	7,465	267,346	3,827	153,103	309	36,705	1,612	152,288	1,123	47,040	821	1,206
November	7,014	7,692	260,707	3,867	157,871	341	33,283	1,680	141,808	1,214	44,071	823	1,322
December	7,155	7,762	265,610	3,916	165,433	395	26,770	1,765	111,333	1,286	39,174	884	1,502
1956:													
January	7,199	8,023	261,592	3,927	183,905	385	21,310	1,923	86,141	1,344	38,247	805	1,422
February	7,208	8,047	259,504	3,854	196,092	385	18,712	1,918	71,335	1,286	35,673	878	1,472
March	7,278	7,914	265,683	3,829	199,698	342	17,215	1,808	60,846	1,213	32,984	934	1,425
April	7,146	7,487	277,121	3,646	193,299	299	18,227	1,713	63,571	1,130	32,740	815	1,305
May	7,064	7,896	277,497	3,859	186,673	292	21,883	1,667	75,928	1,149	36,607	938	1,416
June	7,100	8,071	274,491	3,976	177,076	290	26,111	1,755	93,758	1,098	39,073	987	1,426
July	7,090	8,014	277,008	3,975	176,536	296	28,990	1,767	115,787	1,066	43,958	1,084	1,463
August	7,195	7,995	279,944	4,037	172,939	313	31,826	1,839	137,905	1,091	46,617	1,001	1,399
September	7,054	8,024	278,791	3,991	177,974	329	33,588	1,845	150,411	1,062	47,342	1,043	1,452
October	6,966	7,608	286,560	3,773	172,798	356	35,667	1,772	158,871	1,082	48,400	1,004	1,541
November	7,137	8,027	275,910	3,825	175,405	378	34,574	1,822	153,384	1,183	44,376	881	1,323
Week Ended:													
12-14-56	7,355	8,000	273,707	3,867	177,037	345	32,418	1,943	139,610	1,194	43,145	692	1,227
12-16-55	6,946	7,684	258,059	3,867	160,406	347	29,909	1,725	126,040	1,232	40,935	847	1,348

Source: Data for last two months from API; prior monthly data from Bureau of Mines. Data in thousands of barrels.

Automation Today

Part 7

Parts 1 through 6 present an introduction to this series. They define the action of a controller in the process loop and show how to specify the proper controller action. These earlier parts appeared in issues of the PETROLEUM REFINER starting with April, 1956, and appearing consecutively through September. Part 7 now considers some of the details of the other elements in the process loop. This and subsequent parts will discuss the sampling mechanism, the final actuating element, and even the process itself. Look for them and keep up with the developments in Automation.

Sampling usually is a necessary part of any control loop. Here is a discussion of the types and sources of inaccuracies which may exist for these components of automatic control.

Theodore J. Williams
Monsanto Chemical Company
St. Louis

THE BASIC REASON for carrying on any chemical process is to produce a product of some specific composition (often, although not always, one component as pure as possible). Therefore it would seem that true process control would require us to be able to evaluate this composition at any time in whatever part of the process such evaluation may be necessary for accurate control.

However, this is at best a very difficult task since most chemical analyses are both slow and tedious procedures, usually requiring the direct intervention of a chemist. We must therefore attempt to accomplish our purpose by examining some property of the process or system which can be considered as representative of the composition of the desired product to be obtained from the process under control. Deviations in the values of this property from some specified value would then represent a corresponding error in composition.

The properties which we may use can be separated into two types; *intensive properties*—those which can be used relatively independently of the other properties of the system, and *extensive*—those which are themselves dependent upon at least one other property of the system for their own values.

Tables 1 and 2 list some examples of each of these types of properties along with the restriction on their use or the associated property which must also be controlled.

A further note of explanation is in order here. It must be realized that whether a property is intensive or extensive is a matter of just how well one can specify the system. For example, refractive index is an intensive property only as long as a third component does not interfere with the refractive index—composition relationship of the binary mixture. On the other hand, if pressure could somehow be considered constant, then boiling point could be used directly as a composition indicator.

It is not our purpose at this time to discuss the mechanical details of how the various sampling mechanisms work. This is exceptionally well done in the texts[1,2] and commercial literature on the subject. It is our point here

TABLE 1
Some Normally Intensive Properties Which May Be Used for Sampling Purposes for Process Control

Property	Restrictions
1. Refractive Index	—binary mixture only
2. Electrical Conductivity	—binary mixture only
3. pH	—acid-base system only
4. Absorption spectra	—none
5. Mass spectra	—none
6. Electromotive force	—oxidation reduction system

TABLE 2
Some Extensive Properties Commonly Used in Plant Instrumentation and Process Control and the Associated Property Whose Value Must Be Known

Basic Property	Associated Property
1. Boiling point	Ambient pressure
2. Vapor pressure	Ambient temperature
3. Viscosity	Ambient temperature

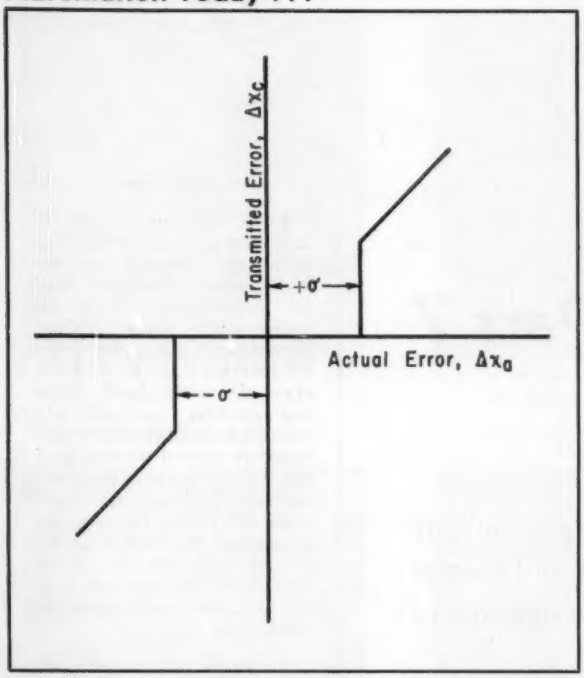

FIGURE 47—A dead space exists when sampling device is unable to detect small deviations of sampled variable from set point.

to indicate some of the difficulties which may arise in sampling and which are important in connection with control theory and for which allowances must be made in specifying the control system. It will be left to the publications we have just mentioned to tell us the physical details of the various devices.

While the sampling mechanism is used to tell us of errors in the process being controlled, it is itself subject to errors in its operation. Since it will be confusing to talk of the error of an error, we will speak of sampling inaccuracies for want of a better term.

TYPES AND SOURCES OF SAMPLING INACCURACIES

In relation to automatic control, sampling inaccuracies may be considered to be of two types. These are (a) *direct*—an inability to determine the actual value of the sampled variable, and (b) *transient or delay*—caused by time delays or true time lags inherent in the construction of the samplers or in the method of evaluating and transmitting the detected error to the controller. Although it may be surprising to the reader at first glance, the second type is often the more important one.

The direct type of inaccuracies can themselves be subdivided into two groups: (a) calibration errors, and, (b) dead space. Calibration errors are important only when they are undetected since they are readily compensated for by changing the set point of the control instrument. Thus vigilance on the part of plant operating and maintenance personnel can nullify any effect from this source.

Dead space, on the other hand, cannot be corrected except by a complete redesign of the sampling equipment. This type of error is the inability of the sampling device to detect small deviations of the sampled variable from the set point. For example, if composition were the variable being sampled, the error transmitted to the controller, Δx_c would be related to the actual error, Δx_a, as follows:

$$\Delta x_c = \Delta x_a \qquad (1)$$

if

$$\Delta x_a \geqq \sigma$$

$$\Delta x_c = 0 \qquad (2)$$

Some Rules for Choosing Sampling Devices

- **Whenever possible, that sampling method should be used which gives the composition of the mixture most directly, i.e., an intensive property. For binary systems such methods as refractive index, electrical conductivity, pH, etc., may be used. For multicomponent streams absorption spectrometers or mass spectrometers appear to offer the best possibilities.**
- **When an extensive variable of the process must be monitored, great care must be taken to assure that changes in any associated variables do not give false error indications to the controller.**
- **Care must be taken by operating and maintenance personnel to assure that calibration errors do not affect the operation of the control system.**
- **Sampling instruments and their mountings and connecting lines should be designed and installed whenever possible in such a way that time delays and true time lags are either eliminated or made negligible in relation to the other time constants of the control loop.**

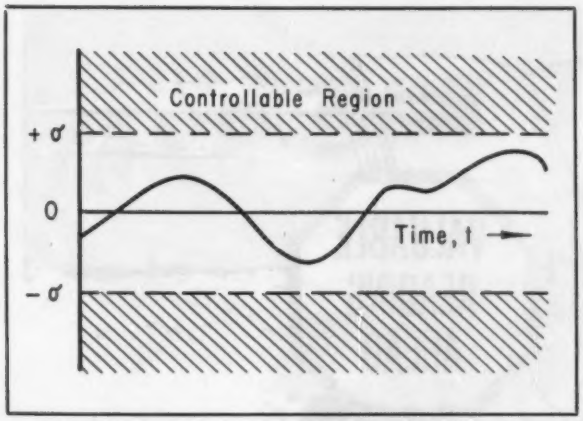

FIGURE 48—The quality of the product cannot be specified to any more refinement than the dead space of the control system will allow.

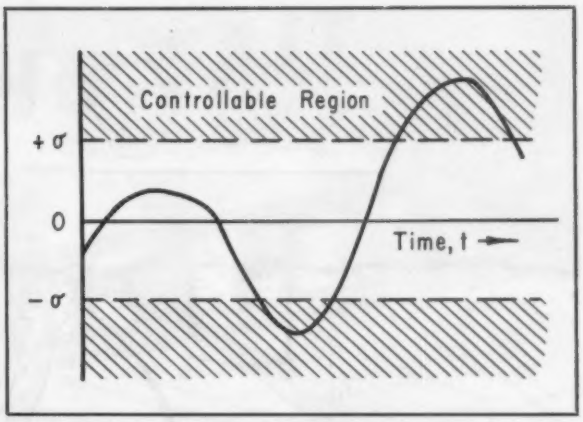

FIGURE 49—The process may build up sufficient inertia to drive the value of the sampled variable a considerable distance beyond the dead space. Too severe correction thereafter may result in oscillation.

when $-\sigma < \Delta x_a < \sigma$, and

$$\Delta x_c = \Delta x_a$$

if $$\Delta x_a \leqq -\sigma \qquad (3)$$

σ represents the amount of dead space in the sampler. Figure 47 is a graph of this relation.

Dead space becomes important in control for two reasons. First, we cannot specify the quality of the product we hope to obtain from our process to any more refinement than the dead space of the control system will allow. Therefore, controller dead space can be an important factor in the economic evaluation of a process. Second, the variable being sampled is free to oscillate over a range of 2σ about the desired set point. In varying from $-\sigma$ to $+\sigma$ or vice versa, the process may build up sufficient inertia to drive the value of the sampled variable a considerable distance beyond $\pm\sigma$ as the case may be, despite controller action. In addition the sudden application of the resulting large error on the controller may generate a correction signal sufficiently large to drive the sampled variable through the dead space and into the controllable region on the other side to repeat the operation. Thus dead space decreases the stability of a system and unless the controller action is kept quite small, it can cause it to be completely unstable. Figure 48 illustrates these occurrences.

Transient or delay inaccuracies, as mentioned before, will be the effect of first or higher order time delays in the detection of an error by the sampler or in its transmission of this error to the controller. They may also be due to true time lags in the sampling mechanism or again in the transmission to the controller.

As mentioned in Part 1, the sampling mechanism and any time delays or true time lags inherent in its operation are as much a part of the control loop as is the process itself or the controller. Therefore the time constants of these delays and lags must be considered in the design of the control system (outlined in Part 6) to the same degree as the time constants of the process or of the controller. The rule that a time constant which is less than one-tenth of the largest in the control loop can be ignored applies here as well as previously. Let us therefore consider how such delays and lags may arise in common industrial practice.

The usual method of obtaining the temperature of a process is through the use of a temperature detecting element such as a thermocouple, a resistance thermometer, or a gas-filled bulb. The temperature which the element actually detects is not that of the process but that of the thermowell in which it is inserted. That is, there is a wall, usually of metal, between the element and the actual desired sampling point. Since the intervening wall usually has a high heat capacity, we have the possibility of an appreciable time constant (this is similar to the effect described in Figure 8 of Part 2).

As another example, most spectrometer type instruments employ a small chamber to contain the liquid being analyzed. If the sample lines leading to the instrument are also small, an appreciable mixing lag can result (see Figure 5 and Equations 1 through 4 of Part 2).

In addition, these instruments are often mounted in a control room and connected by a long sample line to the distillation column or other unit being controlled. The time required for liquid to flow from the sample point on the column to the instrument represents a true time delay in the control loop. As we saw in Part 6, the presence of such a true time delay, especially if the line is quite long, can lead to very serious difficulties in specifying the control system for such a process.

With these examples as a start the reader can undoubtedly think of several other situations or arrangements found in the design and in the use of sampling mechanisms which will also lead to appreciable time delays and/or true time lags.

SYMBOLS USED

a — as subscript, means actual value.
c — as subscript, means transmitted quantity.
x — composition.
Δ — variation in the measured quantity.
σ — dead space.

LITERATURE CITED

[1] Ewing, G. W., *Instrumental Methods of Chemical Analysis*, McGraw-Hill Book Company, New York, 1954.
[2] Holzbock, W. G., *Instruments for Measurement and Control*, Reinhold Publishing Corporation, New York, 1955.

Part 8 Will Appear in the February REFINER

"Polyethylene"

One of the books presented in this months "Reviewing New Books" is Polyethylene, by R. A. V. Raff and J. B. Allen. You will read how these two authors have attempted to summarize the present state of the knowledge of those polymers which, depending on their molecular weight, range from viscous liquids, through semisolids, to tough, flexible solids suitable for use as plastics. Besides this, nine other books are reviewed, so . . .

Keep Going to Page 204

Do It Yourself

This month's "How To Do It" section shows how to make an easy-to-use rack for lathe tools. With this rotating rack, everything is readily accessible at arms length, and if desired, the entire board may be moved from one spot to another. For a quick look at "How To Do It" . . .

Keep Going to Page 207

Twin-Firing

An entirely new idea in process heater design is now in use. The principle involves the double-firing of vertically suspended tube banks in the radiant section of a heater. Read this interesting and informative article in "Who's Building" of how several such heaters have been installed recently as part of a new petrochemicals plant.

Keep Going to Page 215

Another "Boxscore"

Once again this month Petroleum Refiner presents its quarterly compilation of refinery, natural gasoline, and petrochemical plant construction projects from all over the world. Keep pace with construction happenings by studying "Construction Boxscore"—the most complete and up-to-date guide to building in the industry.

Keep Going to Page 233

In a Nutshell

Busy industry men don't have time to read long accounts of what is going on in the industry. For this reason "What's Happening in the Industry" is gaining steadily in popularity. Each news item is presented in as clear and concise a manner as possible, and our new addition "Changing Times" (p. 288) gives you "the news in a nutshell."

Keep Going to Page 274

Mysterious Prober

When you turn to "What's New in Equipment" you will read about a new research tool that probes scientific mysteries with a 3 million-volt beam of atomic particles traveling at nearly the speed of light. It is the most powerful radiation source in industry, and depending on how it is used, is up to 50 times more powerful than the largest cobalt-60 source in industry. For more information plus picture . . .

Keep Going to Page 338

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Reviewing New Books . . .

Polyethylene, by R. A. V. Raff, and J. B. Allison, attempts to summarize the present state of the knowledge of those polymers of ethylene which, depending on their molecular weight, range from viscous liquids, through semisolids, to tough, flexible solids suitable for use as plastics.

The authors have attempted to include the most recent developments in this extremely active field. In isolated instances they have explained facts with theories; integrated structural observations, manufacturing conditions, properties and suitable fields of application; and conveyed a deeper insight into proven or assumed relationships. The highly competitive situation prevents an adequate treatment of more recent developments, that is, the new low-temperature, low pressure processes which are beginning to operate in this and other countries.

(Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y., 547 pages, $16.00. For sale by Gulf Publishing Co., P. O. Box 2608, Houston 1, Texas.)

Micro Tests for Lubricants, reliable minaturized tests for quantities of petroleums, petroleum products, and related materials too small for analysis by macro tests. Reports of three parts are prepared by J. B. Christian and others the Air Force's Wright Air Development Center.

Part 1 contains micro test methods for evaluating the viscosity and neutralization number of petroleum, petroleum products, and related materials. Order PB 121355.

Part 2 describes small-scale tests for determination of the swelling of synthetic rubbers in aircraft greases and hydraulic oils, and of the color of lubricating oil and petroleum by using the ASTM Union Colorimeter. A miniatureized test for hydrolytic stability of aircraft oils also is included. Order PB 121386.

In part 3 micro test techniques are developed for corrosion and oxidation, separation of oil from lubricating greases, and corrosiveness of greases and oils. Order PB 121443.

(Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., PB 121355, 19 pages, 50 cents; PB 121386 21 pages, 75 cents; PB 121433, 26 pages, 75 cents.)

Bibliography on Ignition and Spark-Ignition Systems, by George F. Blackburn, National Bureau of Standards Circular 580. This bibliography contains more than 425 references to books, papers, and reports on ignition and ignition apparatus in internal combustion engines. The material covered includes not only electric equipment for spark-ignition but also firing by means other than compression ignition.

Circular 580 supersedes NBS Letter Circular LC476, *Bibliography of Spark Plugs,* and is wider in scope. The majority of the references were assembled in the course of investigations supported by the National Advisory Committee for Aeronautics, the Navy Bureau of Aeronautics, and other national defense agencies.

(U. S. Government Printing Office, Washington 25, D. C., 15 pages, 15 cents.)

Note: Foreign remittance must be in U. S. exchange and should include an additional one-third of the publication price to cover mailing costs.)

Transport Processes in Applied Chemistry, by R. C. L. Bosworth. The control of a chemical reaction is frequently complicated by the considerations which must be given to the transport of materials and properties associated with the reaction. These processes may include the transport of heat as in conduction, convection, or radiation; of mass as in diffusion or absorption; of electricity as in metallic or gaseous conductors; and many others.

This book considers these processes in general, and then deals with some of them in particular. Those cases where more than a single property must be considered at a given time, are also discussed.

The concepts discussed in this book may be applied to processes other than chemical reactions, such as the efficiency of factory operations, or the economic utilizations of natural resources which may be examined by these methods.

(John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 387 pages, $12.00. For sale by Gulf Publishing Company, P. O. Box 2608, Houston 1, Texas.)

Sodium, by Marshall Sittig, combines all the information currently important in the manufacture, handling and use of sodium with a critical coverage of its physical, chemical and thermodynamic properties.

Contained in the book are 150 illustrations including flow sheets, line drawings, and photographs of equipment and actual sodium handling operations. More than 2000 references give ready entree to the entire body of published periodical and patent literature on sodium, while at the same time the book has been kept to a compact and usable size.

This volume is primarily for the handling of sodium in such as nuclear power plants, but one of the sections presents many of the reactions between sodium and hydrocarbons.

(Reinhold Publishing Corporation, 430 Park Ave., New York 22, N. Y., 529 pages, $12.50.)

ASTM Manual for Rating Motor Fuels by Motor and Research Methods, should enable qualified personnel to install and operate knock testing equipment for both the Motor and Research Methods. This Manual was prepared by ASTM Committee D-2 on Petroleum Products and Lubricants to revise and bring up to date the ASTM methods for determining the knock characteristics of motor fuels by the research and motor methods; and to better serve users of ASTM knock test engines by providing six appendices presenting by word and picture, factual information and data on the operation and maintenance of the knock testing equipment. Methods are: Standard Method of Test for Knock Characteristics of Motor Fuels, by the Motor Method (D 357), and Standard Method of Test for Knock Characteristics of Motor Fuels by the Research Method (D 908), commonly referred to as the Motor and Research methods. Short statements on the essential features of each method are included. The Manual is illustrated throughout.

(ASTM Headquarters, 1916 Race Street, Phila. 3, Pa., 192 pages, $6.75).

The Mechanism of Inhibitors for Chain Reactions. By A. T. Ree and K. Yang, University of Utah, for Air Force Office of Scientific Research. A new theory of inhibition for chain reactions was derived from the Rice-Herzfeld mechanism for the pyrolysis of hydrocarbons. Inhibition curves for butane, pentane, hexane, heptane, octane, nonane and decane were reproduced with good agreement with experiments. Results are given for application of the theory to the inhibition of thermal decomposition of hydrocarbons by nitric oxide.

(Office of Technical Service, U. S. Department of Commerce, Washington 25, D. C., PB 121129, 13 pages 50 cents.)

Oil Industry Background Information Bulletin No. 14—Research and Development Expenditures and Personnel in the Oil Industry, is a new study which emphasizes not only the rapid growth, but also the extensiveness of research and development in the oil industry. It is one of the series of information bulletins issued for the industry and the public by the Institute's department of Information.

This study shows that in 1955, the oil industry spent more than $160 million on research and development work, and utilized the time and talents of almost 15,000 persons. Of these, more than one-third are scientists or engineers, and another one-third are trained technicians. Of the scientists and engineers, more than one-half are chemists and chemical engineers.

In a breakdown of the expenditures, the API study indicated that refining and manufacturing processes got the lion's share—49 cents out of each dollar; exploration and production came next, with 21 cents; petrochemicals, 16 cents; equipment manufacturing, four cents; transportation, one cent; and miscellaneous, nine cents.

(American Petroleum Institute, 50 West 50th Street, New York 20, Free.)

National Petroleum Biography is a completely new type of periodical publication devoted to the petroleum industry. Designed for use as a desk top library file by executives, petroleum technologists and researchers, it is a comprehensive bimonthly index of literature and data pertinent to all oil industry operations.

More than 400 publications per issue, predominantly technical and trade journals, are being indexed in the new bibliography, which also includes current books, technical papers, maps and various special publications of oil and gas agencies and institutions.

(National Petroleum Biography, Box 3586, Amarillo, Texas, bi-monthly, $35.00 [one year subscription], foreign rates on request.)

The Condensed Chemical Dictionary, provides quick accurate data on chemicals, chemical terminology, tradename products, and related substances. Included is data on the chemical and physical properties on chemicals and raw materials; newest information on containers, shipping regulations and safety instructions; and new uses of chemicals in nuclear energy, chemotherapy and other fields of current interest. Many new cross references help clarify the confusion often associated with chemicals and their synonyms.

(Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y., 1201 pages, $12.50. For sale by Gulf Publishing Co., P. O. Box 2608, Houston 1, Texas.)

With 10 years on corrosive waste gases this Crane Valve is still maintenance-free

THE CASE HISTORY—For over 10 years, a large integrated refinery has handled corrosive waste gases on its refinery flare line with this 10-inch No. 47X Crane cast steel 150-pound valve. Used as the main gate valve, it is operated about once a month.

Despite the long periods of inoperation, this Crane valve still has a perfect record for performance, maintenance and service costs—not one nickel has been spent to keep it on the job. It has never leaked, and it operates as easily as it did 10 years ago.

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Now — A Revolutionary NEW Steam Trap!

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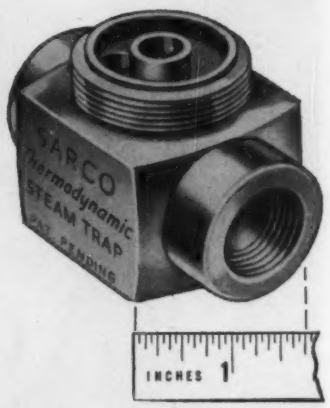

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Look at this revolutionary new thermodynamic steam trap. Could it possibly be simpler? Look for the valve closing mechanism—there isn't any! The kinetic energy of steam closes the valve and *only* the TD uses this new operating principle.

Only 3 parts ... cap, disc and body ... machined from stainless steel bar stock ... all extremely simple, rugged, durable. Only one moving part ... a hardened SOLID stainless steel disc ... practically wear-proof.

Just imagine how much time and expense this new TD steam trap can save you by greatly reducing and simplifying trap maintenance and inventory!

SOME OF MANY OTHER ADVANTAGES:

1. Use the same trap for 10-600 psi ... for light or heavy loads ... without seat or valve change or other adjustments.
2. Closes tight on no load — no steam waste.
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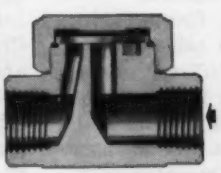
TROUBLE-FREE DESIGN

No valve-closing mechanism to wear or stick—the kinetic energy of steam closes the valve. No critical clearances to choke. No gaskets to leak. Only one moving part—a SOLID stainless steel disc.



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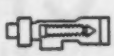

Liquid Expansion Steam Traps

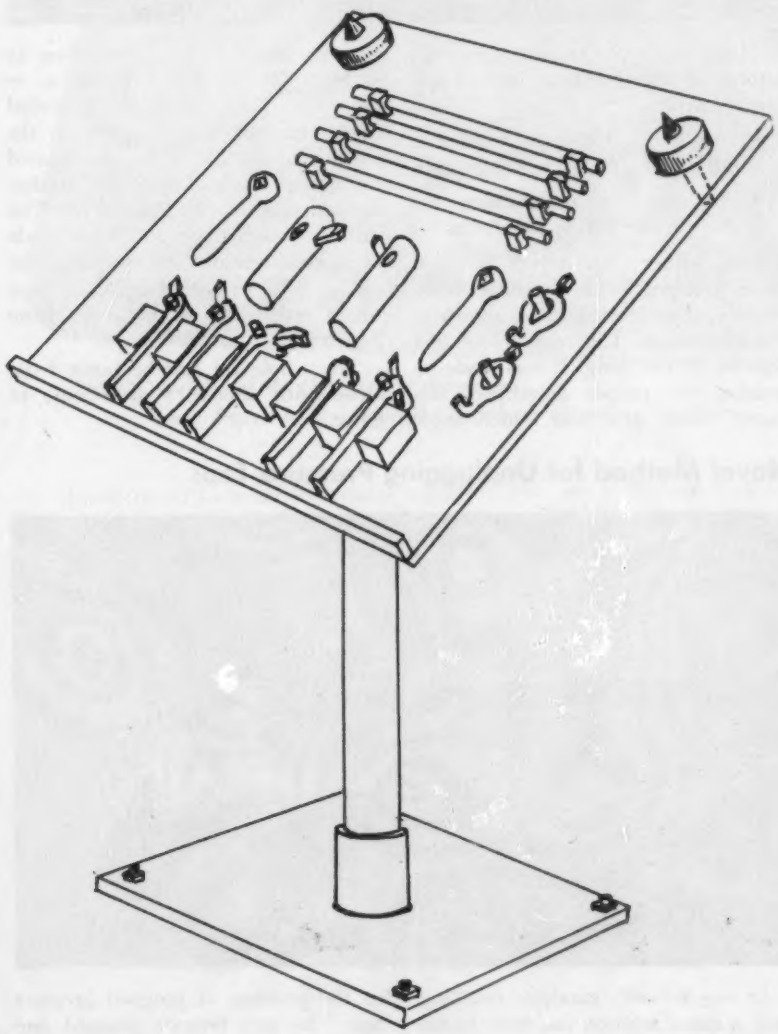
Camlift Bucket Steam Traps

How To Do It . . .

An Easy-to-Make Rack for Lathe Tools

Here's how to have these tools at arms length instead of cluttering up your work bench.

This handy board makes an ideal storage rack for your lathe tools. The board itself is made of ¾-inch plywood as well as the wood stop strip at the bottom of the board. Holes are drilled on either side at the top of the board so that the lathes bell center and live center may be inserted. The boring bars (upper center) are held on wooden blocks attached to the board and shaped to fit the bars. One inch pegs, in the center of the board, allow storage of the boring holders. On either side of the boring bar holders, pegs are also provided for the lathe box wrenches. A row of wooden blocks are provided along the bottom of the board for various tool holders.



The plywood board is attached to a ¼-inch steel plate which is welded to a 1½-inch pipe. This pipe slips into a 2-inch pipe so that the board may be easily rotated. The latter pipe is then welded to a ⅜-inch steel plate that is fastened to the floor.

The machinist can readily rotate the assembly for tool selection and the entire board may be removed for easier access to the lathe.

Easy Ways To Prevent Hose "Wicking"

When the unprotected end of a rubber hose is placed in a liquid such as in a barrel of gasoline, "wicking" may occur that will shorten the effective life of the hose. The liquid will travel up the fibers of the reinforcement of the hose by capillary action similar to the action of kerosine traveling up the wick of the old-time kerosine lamp.

The liquid will attack and weaken the fibers for a considerable distance from the exposed end. "Wicking" may even cause the hose end to swell and eventually to fail. The simplest way to overcome "wicking" is to couple a length of metal pipe on the hose end long enough to prevent contact of the hose end with the liquid. The pipe should, of course, be inserted into the hose and not over the outside cover.

Another easy way to avoid "wicking" is to use a standard metal end protector which will seal the end against contact with the liquid.

A third possibility is the use of a liquid neoprene rubber compound which dries in a durable film over the end of the hose and prevents the

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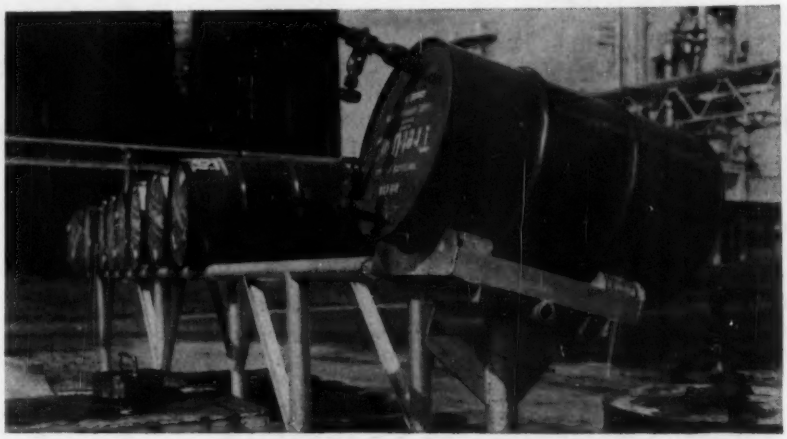
How to Do It . . .

entry of liquids into the fibers of the carcass.

A fourth possibility is dipping the end of the hose in shellac to form a film over the end of the hose. This is only good for water applications and should not be used with strong solvents.

Homemade Rack Facilitates Drum Draining



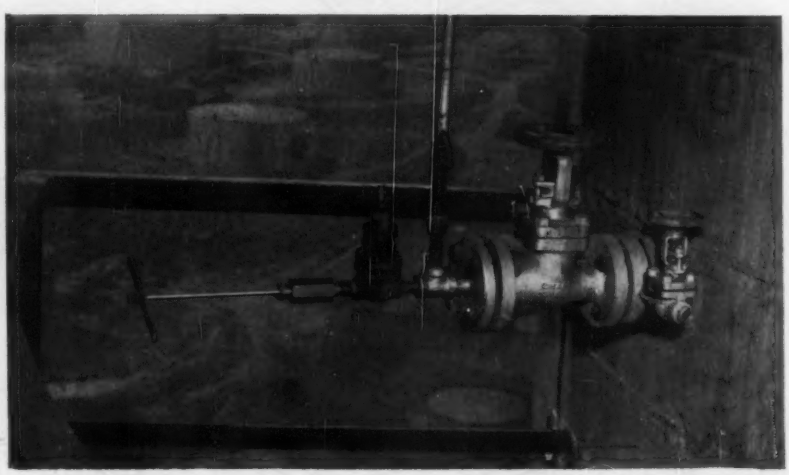
There are two annoying problems associated with handling lube or solvent oil drums.

- They're too heavy to handle—a full drum will weigh 450 pounds.
- The last two or three gallons are likely to be left in the drum.

One refinery has solved both of these problems with the neat, inexpensive, shop-fabricated rig shown in the illustration. The rack is four feet high by 30 feet long. It was made by welding the proper lengths of salvaged 3-inch pipe and 2-inch angle iron. A chain hoist (not shown in picture) lifts the loaded drums on to the rack. They can be easily rolled down the pipe to the saddle on the end. The saddle can be rotated through an angle of about 30" so that the last drop can be drained off. The turning rod for the saddle is made very economically by welding the saddle to a length of 2½-inch pipe which revolves in a slot made from 3-inch pipe.

The whole rig can be made from scrap with about 15 man-hours of labor.

Novel Method for Unplugging Pressure Taps



At one refiner's catalytic cracking unit, a novel solution has been found for the problem of plugged pressure taps. The taps become plugged due

how much could you add to your profit-- by saving $50,000 per boiler cleaning?

Here's An Example Of Such A Savings Made Possible By Dowell Chemical Cleaning Service

Dowell recently chemically cleaned a 1,000,000 lb. per hour steam generator for one of its customers. Total outage time was 48 hours. This saved the company an estimated five to seven days down-time, as compared to mechanical cleaning methods.

Considering replacement power for a boiler of this capacity costs between $7,000 and $15,000 per day, it's easy to see a $50,000 savings. And, it's just as easy to project a $250,000 to $500,000 annual savings for a plant with five to ten such boilers.

This particular case history concerns a power company with a forward-looking operations manager. But, Dowell has other startling performance data to show you — from your own industry. That's because chemical cleaning is so versatile. Dowell engineers are experts in removing scale and sludge from process systems, tanks and piping. They apply solvents in various ways— such as filling, jetting, cascading. Dowell furnishes all the necessary chemicals, trained personnel, pumping and control equipment.

For specific information on how chemical cleaning can help you to greater profits, call the Dowell office near you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

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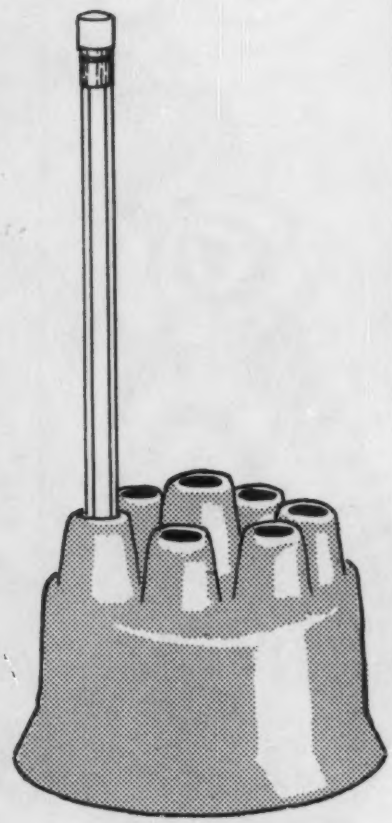
How to Do It...

to the accumulation of catalyst fines in the pressure gage lines. Occasionally a controlled amount of purge air can be used to blow the fines from the lines. More often, the entire manifold must be cleaned. To do this without disturbing the operation of the unit, follow these steps: close the block valve, remove the purge air connection, and install a shop made drill with a packing gland as shown in the photograph. After opening the block valve, the line can be rodded out with the spade-tipped drill. Thus the pressure tap manifold can be cleaned out and placed back in service in a very short time.



Distributor Cap Pencil Holder

If that shop office of yours is cluttered with pencils or even worse, one can never be found, try this simple method to keep those pencils corralled. An ordinary automobile distributor cap makes an ideal holder.

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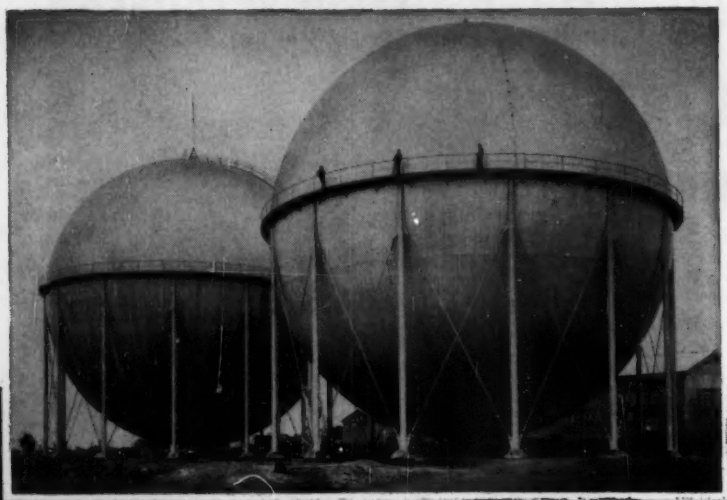


HIGH WORKING STRESS. These vessels are of Chicago Bridge & Iron Company's Hortonsphere construction. They were designed for storing natural gas at a pressure of 71.1 psi in Tokyo, Japan . . . with an earthquake factor of 0.30 and wind pressure of 26 lbs. per sq. ft. on the projected spherical area. USS "T-1" Steel vessels were built to a maximum allowable working stress of 36,000 psi with 90% weld joint efficiency. This stress is about one-third of USS "T-1" Steel's ultimate tensile strength. Each vessel is supported by 14 tubular columns, 18 inches in diameter. The top portion of each column, which is welded to the sphere, is made of USS "T-1" Steel. The columns rest on 14 concrete piers which are interconnected by reinforced concrete struts. Chicago Bridge & Iron Company is now fabricating steel for two additional, slightly smaller vessels of similar construction for Tokyo Gas Works, Ltd.

in Two Giant Pressure Vessels by using USS "T-1" STEEL!

Six conventional pressure vessels would have been required to provide the same capacity, under the same pressure, as these two natural-gas storage tanks made from USS "T-1" Steel.

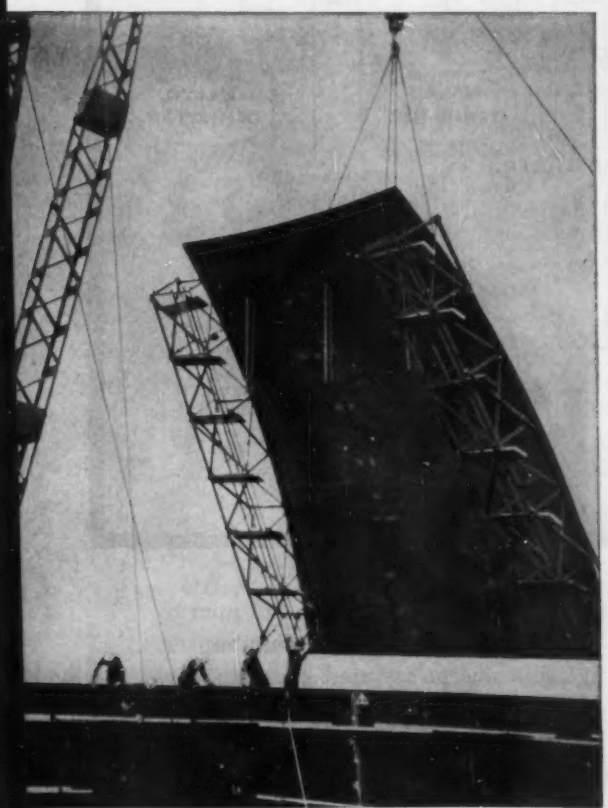
The six conventional vessels would be built with structural carbon steel which has a yield strength only one-third as great as USS "T-1" Steel. As a result, the maximum size of each vessel would be restricted . . . the shell walls would have to be thicker . . . and the six vessels, together, would weigh nearly 2½ times as much as the two vessels that were actually built with USS "T-1" Steel.

The six conventional vessels, being heavier, would have required more foundation material and supports . . . would have been more expensive to ship, to handle, to erect . . . and would have occupied much more ground area.

USS "T-1" Steel—with a yield strength of 90,000 psi—was the only existing steel from which the two large vessels could have been built economically. Structural carbon steel is not strong enough. High alloy steels are not easy to weld—and they cost more than USS "T-1" Steel. USS "T-1" Steel has *both* the extra strength and the excellent weldability that are needed.

These two vessels were built for Tokyo Gas Works, Ltd., Tokyo, Japan, under the supervision of erection engineers of Chicago Bridge & Iron Company. Chicago Bridge & Iron also designed the vessels and fabricated the steel.

NEW BOOKLET AVAILABLE! Our new revised booklet on USS "T-1" Steel gives you complete facts about the application of this remarkable steel. Much new information has been added on welding and fabrication, and all other information has been brought up to date. If you design steel structures, you need this booklet. Write, today, for a free copy. Or get in touch with the nearest USS Sales Office. United States Steel, Room 2801, Pittsburgh 30, Pennsylvania.



FIELD WELDING. Each vessel contains 188 separate USS "T-1" Steel plates (Quenched and Tempered, Firebox Quality), 0.73-inch thick, which were welded in the field with E12016 electrodes. All welds were 100% X-Rayed. The steel was fabricated by Chicago Bridge & Iron Company in Greenville, Pennsylvania. All fittings—including two 16-inch nozzles, two 20-inch manways and many smaller nozzles—were forged from USS "T-1" Steel billets.

A COMPARISON of two typical methods of constructing these Japanese pressure vessels: one, with USS "T-1" Steel, and the other, with structural carbon steel, is shown in the following chart, courtesy of Chicago Bridge & Iron.

	USS "T-1" Steel Full X-Ray Required	Structural Carbon Steel Full X-Ray 90% Joint
Pressure	71.1	71.1
Stress (psi)	32,400	13,500
Diameter (Ft.)	110.5	79.17
Wall Thickness (In.)	.73	1.25
Geometric Volume (Cu. Ft.)	707,000	260,000
Weight (Each Vessel) Tons	625	545
Number Of Vessels Required To Provide 1,414,000 Cu. Ft. Geometric Cap.		5.45
Total Weight Tons (All Vessels)	1,250	2,970
Weight Saving Using "T-1" Steel (Million Pounds)	3.44	

USS "T" CONSTRUCTIONAL ALLOY STEEL

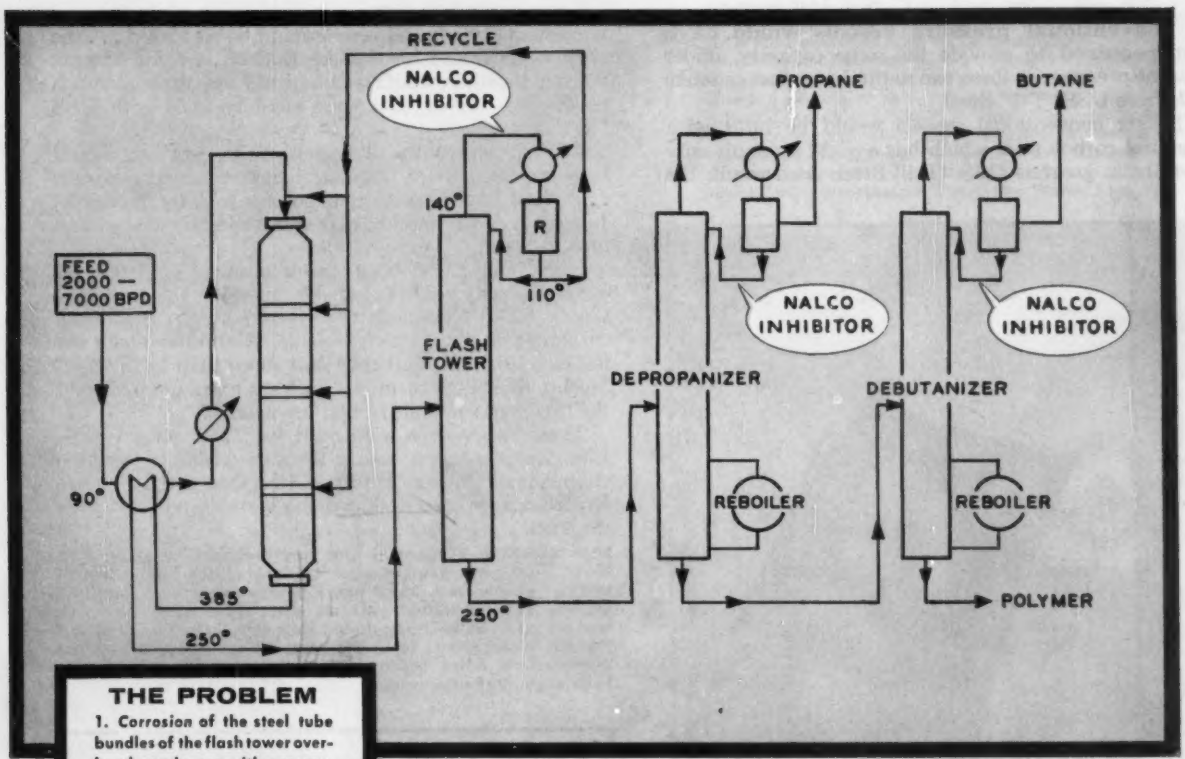
UNITED STATES STEEL CORPORATION, PITTSBURGH - COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

UNITED STATES STEEL

Nalco INHIBITORS

STOPPED CORROSION and FOULING

in this CATALYTIC POLYMERIZATION UNIT



THE PROBLEM

1. *Corrosion* of the steel tube bundles of the flash tower overhead condenser with accumulator water pH of 4.5 or below.
2. *Serious fouling* of screen trays in the depropanizer and debutanizer on normal six-month run.

THE TREATMENT

Nalco Inhibitor fed to the overhead of the flash tower, and to the reflux of the depropanizer and debutanizer towers.

THE RESULTS

1. Iron content of accumulator water reduced from .75 pounds per day to .04 pounds per day.
2. No deposits in screen trays after six-month run.

CONSIDER further the economy of dosage . . . 10 ppm to flash tower, and 10 ppm to depropanizer and debutanizer. And bear in mind that this was no isolated success story. The same advantages—less downtime, better thruput *and* effective protection for costly equipment—can be brought to your refinery by the use of Nalco Corrosion and Fouling Inhibitors. Ask your Nalco Representative or write direct.

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THE *Nalco*® SYSTEM . . . *Serving Industry through Practical Applied Science*

Who's Building . . .

New Design Reduces Radiant Section

Tubes are double fired and vertically suspended to receive more even heating in this furnace design.

An Entirely New Idea in Process heater design is now in use at Sun Oil Co.'s Marcus Hook, Pa. refinery. The principle involved is the double firing of vertically suspended tube banks in the radiant section of a heater.

Several such heaters, designed jointly by Sun's Engineering division and the Alcorn Combustion Co., were recently installed by Sun as part of its new petrochemicals plant.

The process stream is heated entirely in the radiant section where the tubes are arranged in a vertical position. Horizontally-mounted burners are located on both sides of the tube banks and at several elevations. Since each of the tubes stands in the same vertical plane and receives an equal amount of heat from both sides, there is a minimum variation in the circumferential heat density around the tubes. Because the burners are located at different elevations along the tubes, the longitudinal variation in heat density is negligible.

Application of heat in this arrangement permits a one-third reduction in the mount of radiant tube surface that must be provided as compared to a conventional wall-tube heater design.

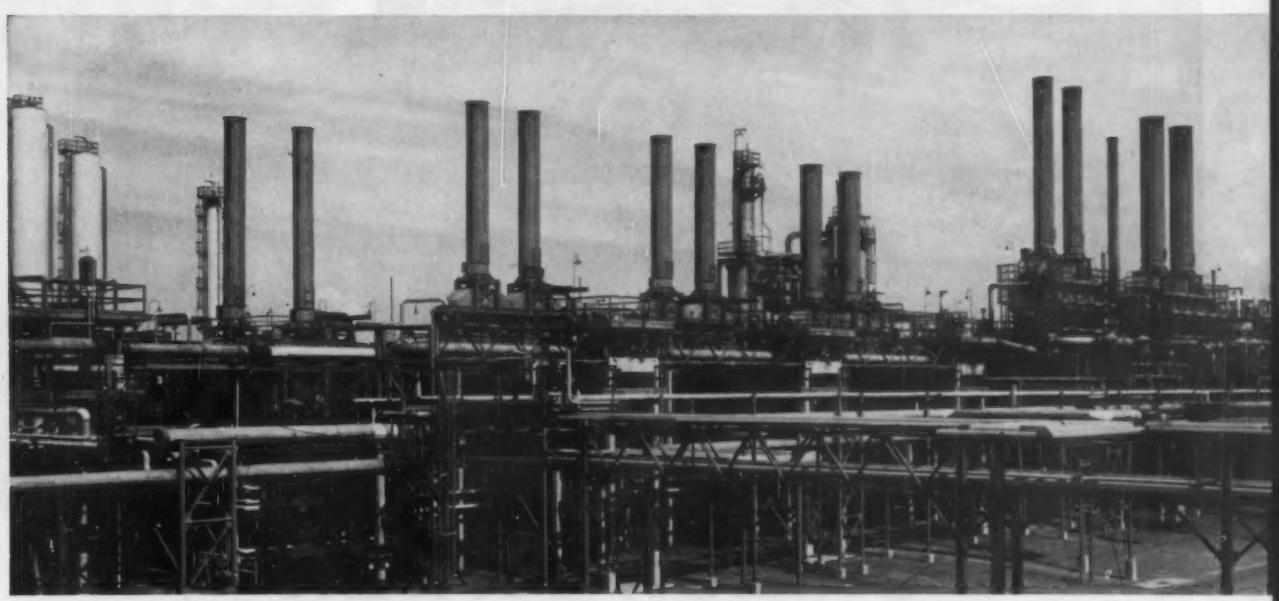
The convection section of the heater is mounted on top of, and lengthwise to the firebox. It has a horizontal tube arrangement and is designed to generate 450 psig process steam. The over-all efficiency of the heater is 82.5 percent, based on the net heating value of the fuel. It is designed for combination oil-gas firing.

Several structural and mechanical advantages are included in this design. Since the vertical tubes are suspended at the top and merely guided at the bottom, they remain perfectly straight at high temperature levels. This suspension-guide arrangement also eliminates the need for costly intermediate tube supports.

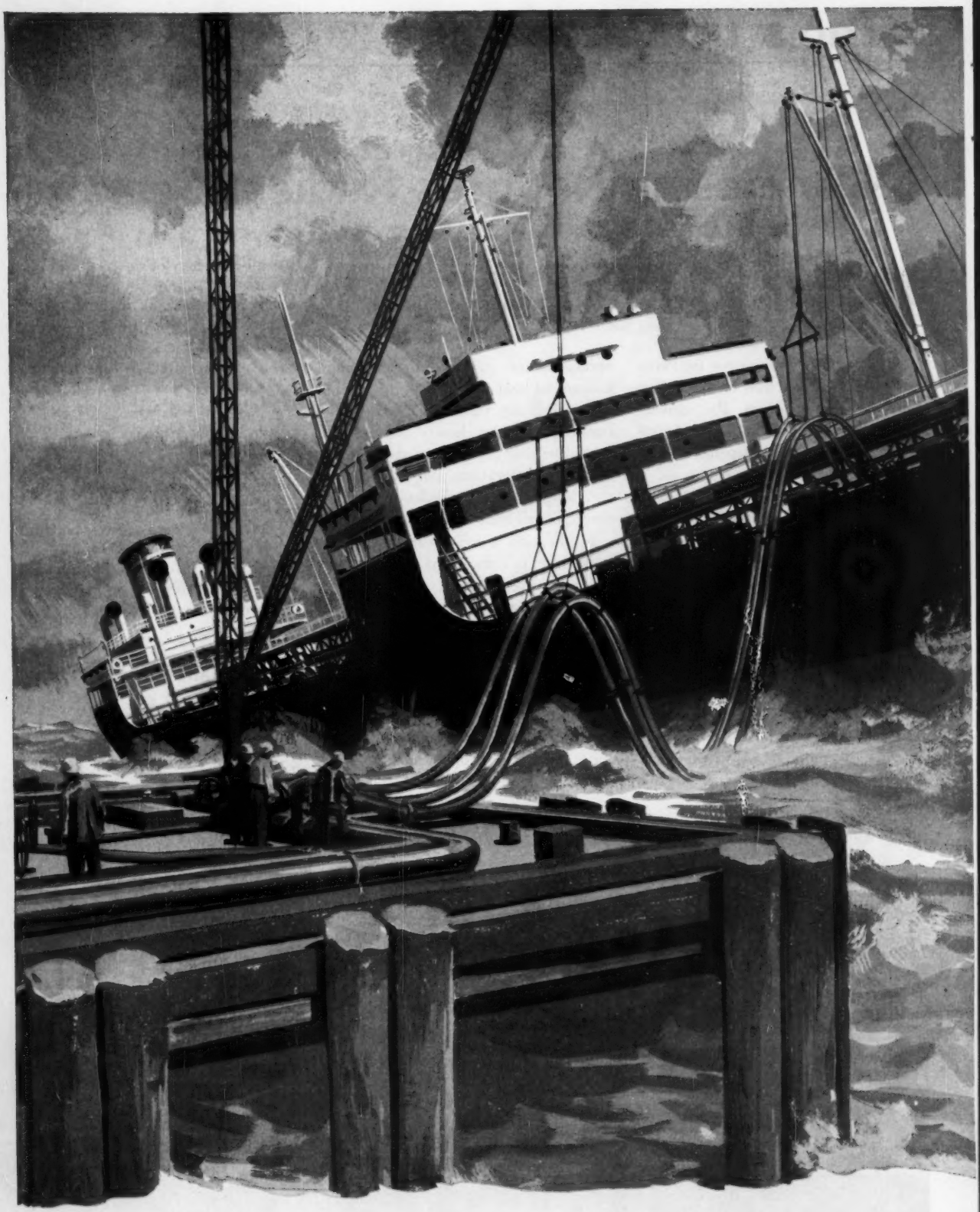
The vertical-tube coils may be completely shop-fabricated and heat-treated prior to installation in the heater as assembled units. Ground space requirements for these heaters are small.

Socony Plans Four New Units

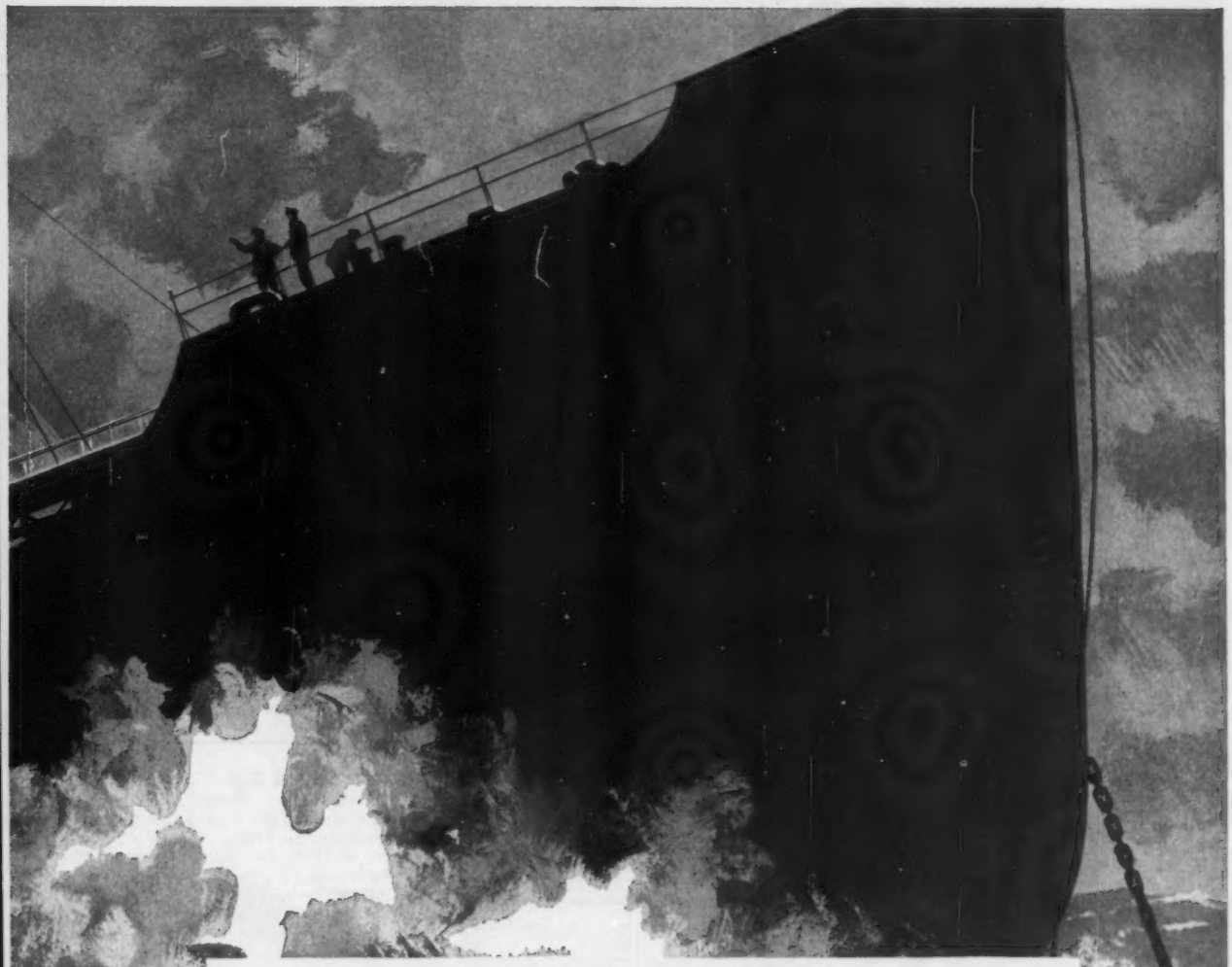
Socony Mobil Oil Co. has announced plans for construction of new processing units at four Mobilgas refineries. A contract has been awarded



Twin stacks at Sun Oil Co.'s Marcus Hook refinery mark the latest design in heaters which can supply as much as 400 million Btu's an hour.



INDUSTRIAL HOSE • CONVEYOR BELTING AND MACHINERY • VIBRATING EQUIPMENT • DESIGN, MANUFACTURE,



STORMY PETROL

This tanker must be loaded half a mile at sea without protective harbor or breakwater. When heavy seas are running, she must be moored 75 to 100 feet from the dock. The hose bridging the gap was failing prematurely, until Hewitt-Robins "Monarch" Hose was installed. Service records now show more barrels per length of hose than ever before.

Building better loading hose to feed storm-tossed tankers is but one of the ways that Hewitt-Robins is helping industry through better bulk materials handling equipment. To obtain complete information about Hewitt-Robins products and services, refer to our classified telephone listings or write directly to our office in Stamford, Connecticut.

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Who's Building...

to the M. W. Kellogg Co., New York City, for erection of a sulfuric acid alkylation unit at the Buffalo, N. Y., refinery. The unit is designed to produce 2435 b/d of alkylate.

Another sulfuric acid alkylation unit, with a capacity of 3500 b/d will be built at the refinery at Trenton, Mich. Construction contract for this unit has been awarded to The Fluor Corp., Los Angeles, Calif.

A catalytic reforming unit will be built at the Augusta, Kan., Mobilgas refinery. This unit will have a throughput capacity of 9000 barrels per stream day and will employ an alumina catalyst impregnated with platinum. The construction contract has gone to J. F. Pritchard and Co., Kansas City, Mo.

Two new units are to be built at the Casper, Wyo., refinery. In addition to a 3000 b/d catalytic reformer and pretreater, the construction program includes a 3250 b/d catalytic hydrodesulfurization unit. J. F. Pritchard and Co. will construct both these units.

The Girdler Co. will design and build a packaged Girbotol plant for Delta Refining Co., Memphis. It will purify 1500 b/d of a propane-butane liquid hydrocarbon mixture by removing 10,000 pounds of hydrogen sulfide.

A twenty percent water solution of diethanolamine will be employed in a liquid phase absorber to scrub the hydrogen sulfide from the hydrocarbon. The amine solution will be regenerated in a conventional reactivator for subsequent reuse in the absorber.

Girdler, a division of National Cylinder Gas Co., Chicago, expects to have the plant completed by February, 1957. It is being prefabricated in Louisville.

International's Talara Refinery Continues Postwar Expansion

Since World War II International Petroleum Co., an affiliate of Standard Oil (New Jersey), has invested just under $7 million in new equipment to modernize and increase the capacity of its refinery located at Talara, Peru.

The major item in this modernization program was $3 million expenditure for a new 45,000 b/d atmospheric crude pipestill. This unit was built to replace a battery of five shell stills dating from World War I. It increased the refinery's crude charge capacity from 33,500 to 45,000 b/d when it was put on stream in July, 1954. Until that time, two of Talara's four thermal cracking coils had been used as crude distillation units with a third operating on a part-time basis. After the new pipestill went on stream, these units reverted to full-time cracking. This increased the refinery's reduced crude cracking capacity from about 6000 to 16,000 b/d.

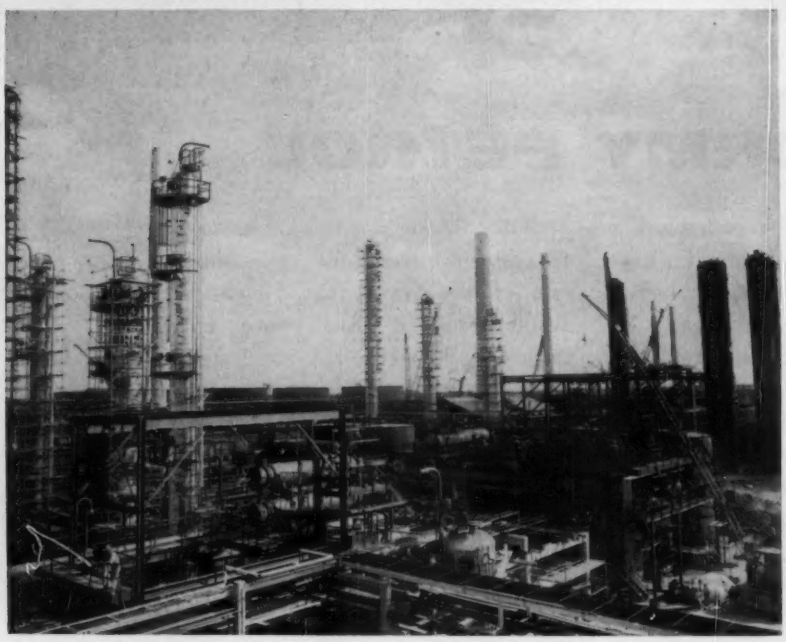
Additional tankage was required because of increased thruput. By the end of 1956 almost $2 million was spent on new and replacement tankage. At the same time, new bulk loading facilities required to reduce tanker turnaround time were installed at a cost of about $100,000. About 98 percent of the refinery output is moved by tanker.

In addition to producing the major petroleum products, the Talara Refinery also turns out propane, solid and liquid asphalts, lube oils and greases. A new grease plant, having a rated capacity of 6 million pounds per year, was recently placed in operation. Over $250,000 has been spent since 1950 for the new grease plant and for modernizing the lube oil compounding and blending plant with its packaging equipment. Tankage installed 10 years ago for handling LPG was found inadequate as the result of the increased demand in Peru for this product. Consequently, two additional storage tanks are now being built.

During the postwar period, utility production and distribution were improved when over $1 million was spent to modernize power generating facilities and to construct a new steam generating plant and a salt water pump station.

Shortly after the war the Talara Refinery, after evaluating the effectiveness of its fire fighting system, decided to install more modern equipment. This program of modernization is now about half finished. It will be completed some time in 1957 at a cost of just over $200,000.

Iraqui General Director of the Oil Refineries Administration has reportedly requested bids for expansion of the Daura refinery at Baghdad from 25,000 to 48,000 barrels per day. Closing date for the bids is April 1, 1957.



Flying A Refinery Nears Completion

Shown are two of the 11 major manufacturing units nearing completion at Tidewater Oil Co.'s new Delaware Flying A refinery. In the foreground is the alkylation plant, and at the right is the catalytic reformer. The 130,000-bpd refinery is scheduled to go into large scale production shortly.

Esso Standard S A F expects to complete construction of its new catalytic cracking unit at the Port Jerome refinery in northwestern France during the first quarter of 1957. The unit is rated at 20,000 b/d, and its principal output will be high-octane fuels, liquefied gases, and feed stock for petrochemicals.

Reportedly, construction of a new hydroformer is being contemplated for the Port Jerome refinery.

Hooker Electrochemical Co. has completed a $5 million plant at Kenton, Ohio, for the output of plastic moulding compounds.

Shell Oil Co. will add 20 million pounds a year of isopropyl alcohol in an expansion program at its plant on the Houston ship channel. Two distillation towers, four converters, and water cooling facilities will be added; cost of the project was not disclosed. The work at Houston is part of a general Shell expansion program which also involves plants at Norce, La., and Dominguez, Calif. Upon completion, a total of 120 million pounds yearly will have been added to present production.

Clark Oil and Refining Co. will build a 16,000 b/d fluid catalytic cracker, a 16,000 b/d alkylation plant, and a gas recovery unit at its Blue Island, Ill., refinery. The new units will go on stream sometime this year. These new units plus the recently completed crude topping unit are part of a $5 million expansion program.

Creole Petroleum Corp. will build a 500 b/d lube oil plant at its Amuay refinery in Venezuela. Construction will start in April with completion slated for early 1958. This project is part of a general

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Dicalite filtration breaks this emulsion...and slop oil filtration units now operating with Dicalite prove that it's not only economical, but profitable! Reports from several refineries indicate that the value of the separated, clean oil recovered by Dicalite filtration will amortize the entire cost of the filtration unit in less than two years, after which oil recovery will return a clear operating profit.

Dicalite diatomite filteraids break this tight emulsion by rupturing the minute oil globules as they pass through the filter cake, and by trapping the minute solids which help to make this emulsion so stable. After filtration, clean oil and water separate easily into distinct layers on standing. The water contains so little oil that it may be re-cycled for process water in some applications, or may be discharged to waste without violating the stream pollution laws of any state.

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Who's Building...

expansion program at Amuay. Later, a fourth pipe still will be added which will eventually bring the total crude capacity to about 300,000 b/d by 1958.

Standard Oil Co. (New Jersey) is still planning on building its 40,000 b/d refinery in Norway. Presently, Norway is studying a Standard proposal to build the $30 million refinery on the east side of the Oslo fjord. The company, A/S Norske Esso now has a 1800 b/d skimming, lube, and asphalt plant in that country.

Monsanto Chemical Co., St. Louis, Mo. plans to expand its capacity of phenol by investing several million dollars in additional production facilities at its Monsanto, Ill., plant. The expansion, scheduled for completion in the second half of 1958 will boost Monsanto's phenol capacity by approximately 25 percent.

Du Pont Co. (United Kingdom), Ltd., has taken option on a 381 acre tract in northern Ireland as a prospective site for a neoprene synthetic rubber plant. The site is four miles northeast of Loundonberry and 55 miles northwest of Belfast. A major portion of the acreage was the former Maydown Airdrome, a military flying field used during World War II. Construction of the plant is expected to commence early this year, assuming successful completion of engineering and economic studies now under way.

Tidewater Oil Co. has awarded a contract to Bechtel Corp. for construction of a 22,500 b/d Houdriformer at its Avon refinery near San Francisco. Work will start on the plant early next year and will be completed in 1958.

Texas Natural Gasoline Corp.'s new natural gasoline recovery plant, 30 miles south of Glendive, Mont., has gone on stream. The plant will process wet gas from the Pine and Cabin Creek fields in Wibaux and Fallon counties.

Humble Oil & Refining Co. will construct a large ethylene recovery plant the first part of this year at its Baytown refinery.

The unit, a part of Humble's program of expansion in the petrochemicals field, is scheduled for completion about the middle of 1958. It will recover more than 80 million pounds of high purity ethylene a year from refinery gases using a low temperature fractionation process. Its capacity could be more than doubled by later equipment additions.

Construction of the unit will be in conjunction with the new fluid catalytic cracking unit and associated light ends units which will also be built at the refinery next year.

Clark Oil & Refining Co. has completed the 1956 phase of a $5 million expansion program with expenditures of more than $2 million since the growth project was announced.

The expansion program will boost output at the firm's Chicago refinery from 21,000 to 30,000 barrels daily. A two-year

Tuffy® Sling Bulletin

Reporting the Outstanding Performance of Union Wire Rope's Machine-Braided Wire Fabric Slings.

3,200-Lb. Bell Rides High on 1½-Lb. Tuffy Sling

Tuffy takes unusual jobs in stride. The bells are safely in place atop the 180-ft. carillon tower of the new St. Luke's Methodist Church in Oklahoma City, and a Tuffy Sling played an important part in getting them there.

The contractor (who used Union Wire Rope 100% on this building) asked Union Wire Rope Corporation to come up with a sling strong enough to lift the 42 bells (one at a time) into place in the tower. The bells ranged from a little fellow of 22 pounds to a giant of 3200 pounds. What's more, an eye of the sling would have to be put through a 1-inch hanger at the top of the smallest bell.

Ticklish assignment? You bet. Those bells were made to special order in Holland. But we had the answer in one of our ⅜-inch U-1 Tuffys. The job of raising $31,000 worth of bells, entrusted to a $7.40 Tuffy Sling, was safely accomplished.

Machine-Braided Wire Fabric Popular Successor to Wire Rope in Sling Construction

The unique machine-braided construction of Tuffy slings provides a combination of super flexibility and extra toughness never possible with ordinary wire rope. The difference is in the patented 9-part fabric, braided by machine in a process that eliminates inequalities of hand-braiding. Result: a fabric which can be bent easily and repeatedly around small radii or abrupt corners.

So Flexible Kinks Pound Out Without Sling Damage

Tie a knot in a Tuffy sling. Pull it as tight as you can with your hands and feet. Then untie it. See how easily the braided fabric straightens out again. You kink it with the aid of a vise, but it's still easy to straighten the fabric without material damage. If one of the nine parts is cut or broken under severe punishment or abuse, it does not result in stranding. No need to tell you this flexibility eases and speeds the hitching and unhitching of loads.

Tuck-Splicing & Pressed-On Ferrule Make Eyes "Tuffy Tough"

The development of Tuffy machine-braided fabric, with its big user-economies of greater strength, faster handling and longer service life—was followed by the introduction of the revolutionary Tuffy ferrule.

This ferrule, slipped over the tuck-splice of the eye and pressed on under great pressure, holds so tight that it gives the eye of the sling 100 per cent of the strength of the fabric. Result: greater safety, speedier handling, more sling-eye strength—at no increase in cost!

Mail Coupon for Free Tuffy Sling Handbook

60 pages packed with information about new, factory-fitted Tuffy slings with pressed-on super-strength ferrule. Plus facts on nearly a dozen new and standard fittings, and complete data and charts on all Tuffy slings. And a brand-new engineer's notebook and riggers manual. Send for your copy now.

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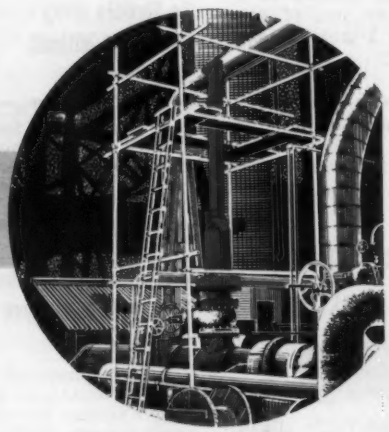

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Who's Building...

target date for completion was set when the program was announced six months ago.

Texas-U. S. Chemical Co. has purchased the 26-acre Sedgefield Manor property in Parsippany-Troy Hills Township of Morristown, N. J., for the construction of a research center. Final papers for the property sale were signed by attorneys representing Texas-U. S. and the seller.

Work will start immediately to convert space in a house on the property into offices. Construction of a center for research on synthetic rubber and petrochemicals will get underway next year.

Tidewater Oil Co. has placed in operation three large petroleum processing plants at its new Delaware Flying A refinery. They are a 102,000 b/d Orthoflow fluid catalytic cracking plant, a gas plant, and a catalytic polymerization plant.

In September, a 130,000 b/d crude distillation plant became the first unit to go on stream at the refinery site 15 miles south of Wilmington.

The greater portion of the partly finished products from the four units now in operation are being placed in storage pending completion of several other major units still under construction. The entire refinery is scheduled to be operating early this year.

National Cooperative Refinery Association has completed construction of a 1560 b/d alkylation unit at McPherson, Kan. The unit is licensed by Universal Oil Products Co., and was designed and built by The Refinery Engineering Co., Tulsa.

Sioux Oil Co. is building a natural gasoline plant at Newcastle, Wyo. Dry gas from the plant will be used as fuel at Sioux's two refineries at Newcastle. Plant capacity will be about 4 million cu. ft. daily.

General Aniline and Film Corp. has awarded a contract to SD Plants, Inc., construction subsidiary of Scientific Design Co., to build an $8 million plant at Linden, N. J., to produce ethylene oxide and ethylene glycol. Work has already started on the project which is located adjacent to Esso Standard Oil Co.'s Bayway refinery which will supply ethylene for the process.

General Aniline will use the direct air oxidation process licensed by Scientific Design Co. The plant will be capable of producing 60 million pounds of ethylene oxide and 35 million pounds of ethylene glycol annually.

Rheinische Olefinwerke, the German firm, will hike production of high-pressure polyethylene and styrene monomer at its Wesseling plant from 10,000 tons a year to 30,000-35,000 tons a year. Cost of the expansion will run around $33.3 million, with completion expected by 1958.

Tokyo Rayon and **Teikoku Rayon** are negotiating with Imperial Chemicals Industries for an 11 year license to pro-

For more data on advertised products, use Readers' Service Cards, last page.

FOR CATALYTIC REFORMING

4 B&W Refractory Castables

with low iron content

B&W Kaocast

Ten years ago, B&W introduced this 3000° castable which offers a combination of high temperature use limit, as well as very low iron content. B&W Kaocast can either be gunned or cast in place.

B&W Kaocrete-LI

After two years of extensive field service, B&W adds Kaocrete-LI to low iron content castables. B&W Kaocrete-LI, which has an iron content of less than 1%, has exceptionally high strength for resistance against abrasion and erosion. It has sufficient refractoriness for use at temperatures to 2700 F. Suitable for both gunning and casting.

B&W Kaolite-LI

Another new castable with over two years of field service, B&W Kaolite-LI has high insulating properties due to its light weight (only 59 pounds per cubic foot). Its iron content is also less than 1%. It is designed to be applied with a cement gun only. Installation and maintenance time can be cut since Kaolite-LI does not require water curing and heat can be applied directly after gunning.

B&W Kaocrete-32

Developed for special high temperature service, B&W Kaocrete-32 has extremely high strength and a use limit of 3200 F. It can be poured, plastered or gunned into place.

Properties of B&W Low Iron Content Castables

		B&W Kaocast	B&W Kaocrete LI	B&W Kaolite LI	B&W Kaocrete 32
Use limit, °F		3000	2700	2300	3200
Melting point, °F		3200	3100	2700	3297
Average density lb/cu ft after firing		126	131	59	134
Average % Fe_2O_3		1.0	0.9	0.8	1.0
Cold crushing strength—psi average—after heating for 5 hrs. at:	1000 F	700	2500	350	1000
	1500 F	500	2500	350	800
	2000 F	400	1200	300	750
	2200 F	500	1300	450	1000
	2400 F	500	1600	—	2000
	2600 F	1000	6000	—	3000
	2800 F	2200	—	—	3500
	3000 F	3500	—	—	4000
	3200 F	—	—	—	5000
Permanent linear shrinkage—average % less than—after heating for 5 hrs. at:	1000 F	0.3	0.2	0.3	0.2
	1500 F	0.3	0.2	0.4	0.2
	2000 F	0.5	0.2	0.4	0.2
	2200 F	0.5	0.2	0.6	0.4
	2400 F	0.5	+0.1	—	0.5
	2600 F	0.5	—	—	0.5
	2800 F	0.5	—	—	0.5
	3000 F	0.3	—	—	0.2
	3200 F	—	—	—	0.1

Consult your B&W Representative for additional information on these and other B&W Refractories for the refining industry.

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That's why it pays you to use this hydraulic setting refractory for temperatures to 3000F

Blazecrete* linings last longer because they resist spalling, withstand slagging action, and are not harmed by rapid temperature changes.

Thus you cut down on refractory maintenance costs—and you save on labor costs, too, because Blazecrete goes on fast. For troweling, just mix Blazecrete with water as you'd mix ordinary concrete . . . then slap-trowel it in place. When gunned, it adheres readily with a minimum of rebound loss. Either way, Blazecrete may be applied easily without laborious ramming or tamping.

Three types of hydraulic-setting Blazecrete are available. All harden on air curing, do not require prefiring. They are furnished as a dry mix—can be stored safely for use as needed.

3X BLAZECRETE—For temperatures through 3000F. Unusually effective for heavy patching, especially where brickwork is spalled or deeply eroded. Excellent for forge furnace linings, lime kilns, burner blocks, soaking pits, and industrial boilers.

STANDARD BLAZECRETE—For temperatures through 2400F. Makes repair work easier and less costly. Can be used by boiler manufacturers to replace fire clay tile in wall construction. Suitable for use in combination with 3X Blazecrete and L. W. Blazecrete.

L. W. BLAZECRETE—For temperatures through 2000F. An insulating refractory . . . light in weight, low in thermal conductivity. Adaptable and economical for many other applications.

Send for Brochure RC-28A on Blazecrete and its companion material, Firecrete*. . . the hydraulic-setting castable refractory for making special shapes and linings. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

*Reg. U.S. Pat. Off.

Whether you gun it... *or slap-trowel it...*

Johns-Manville BLAZECRETE

BUILDS BETTER REFRACTORY LININGS

Who's Building...

duce Terylene. By April, the two firms hope to be turning out five tons a day of the fiber.

Phillips Petroleum Co. will build a 3000 b/d combined feed fluid catalytic cracking unit at its Great Falls, Mont., refinery. Procon, Inc. will do the construction with on stream date scheduled for spring of this year.

Apache Powder Co. plans to build a 30 ton a day ammonia unit at Benson, Ariz.

The Iraq Government is expected to request bids for the construction of a plant at Kirkuk to extract sulfur from natural gas. A plant with extraction capacity of about 275 metric tons of sulfur per day is envisioned.

Cities Service Co. has announced plans for a $30 million expansion of refining and marketing activities in Canada. Major item will be construction, during 1957, of a 20,000 b/d refinery in the Toronto area, at a cost of approximately $22 million. Location of the refinery in the Toronto area was determined by that area's ready access to growing markets, pipeline transportation from Canadian oil fields, and water transportation via the new St. Lawrence Seaway. Engineering contractors are C. F. Braun Co. of Canada, Ltd., Toronto.

Shell Chemical Corp. has announced the completion of two new Epon resin units at its Houston plant that will triple its production of the resins. One of the units will produce liquid grades of the resin and the other solid grades. The unit to produce liquid grades will go into production early this month. The second unit is now in production. Previously, the liquid resins were produced alternately with solid grades in other units at the Houston plant.

Petroleum Chemicals, Inc., has announced plans for construction of a multimillion dollar petrochemical plant at Lake Charles, La., to produce 200 million pounds annually of ethylene for industrial use. P. C. I., which is owned jointly by Cities Service Co. and Continental Oil Co., recently moved its general offices from New York to New Orleans.

The new plant will be one of the first to offer commercially both the standard and high-purity grades of ethylene. The Lummus Co. is the contractor.

Construction on the Lake Charles installation was started a month ago, and completion is scheduled for January, 1958. It will be built adjacent to Petroleum Chemicals' butadiene facility at Lake Charles.

The Conoco and Cities Service refineries at Lake Charles will supply refinery gases as the raw material for producing ethylene at the new plant.

Douglas Oil Co. of California has awarded a contract to the Macco Corp. for the construction of a unifining process unit at the company's Bakersfield refinery. As the first step in a planned

For more data on advertised products, use Readers' Service Cards, last page.

SHEFFIELD
ARMCO

How Sheffield Steel Serves a Booming Market

The Liquefied Petroleum industry is flashing one of the most phenomenal growth records on the industrial scene today. From one million in 1940, consumers of this heat-rich, clean fuel have multiplied to nine million.

Along with matching Sheffield steel plate for forming into tank shells, the deep drawn, semispherical Sheffield tankheads pictured go to tank manufacturers across the nation.

The uses of LP gas are numerous and expanding. On the farm, it performs such chores as cooking, heating, refrigeration, machinery and tractor propulsion, crop drying and weed-burning—and now air conditioning.

In addition to this growing LP gas market for these pressure vessels made of Sheffield steel components, another big potential market looms up in the handling of liquid fertilizer. It seems a certainty the demand for pressure vessels will continue. If you have an active interest in this booming industry let us tell you how we can serve your need.

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for Quality Carbon and Alloy Steels Needed In Products of Your Manufacture—Ingots, Blooms, Billets, Plate, Structurals, Merchant Shapes, Manufacturers Wire, Bolt and Nut Products, including Structural Bolts.

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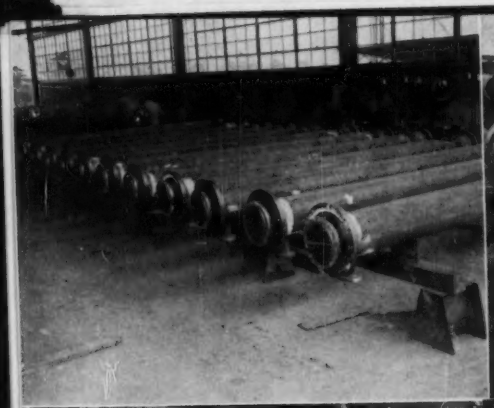

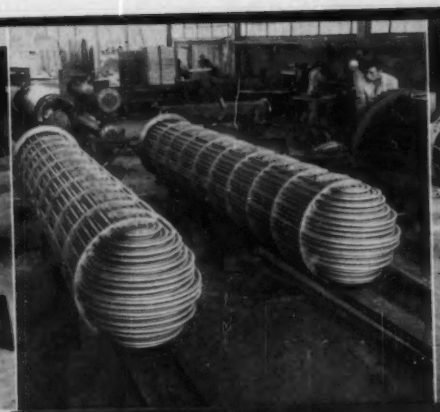

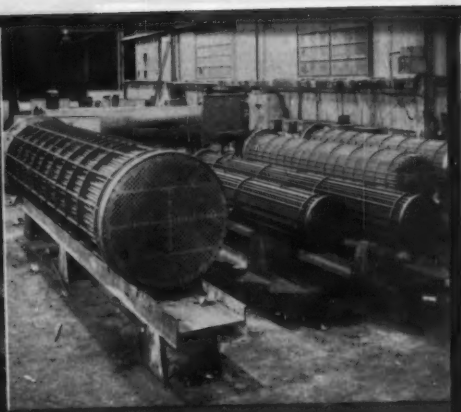

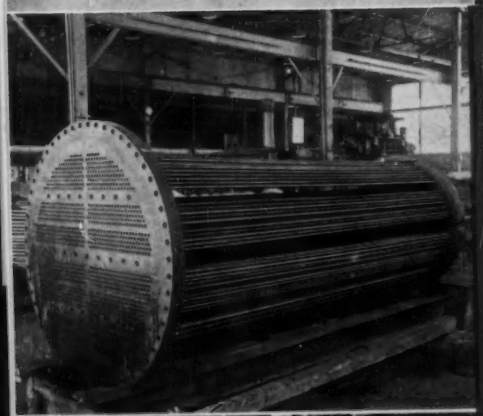

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Performance engineered to fit YOUR heat transfer needs.

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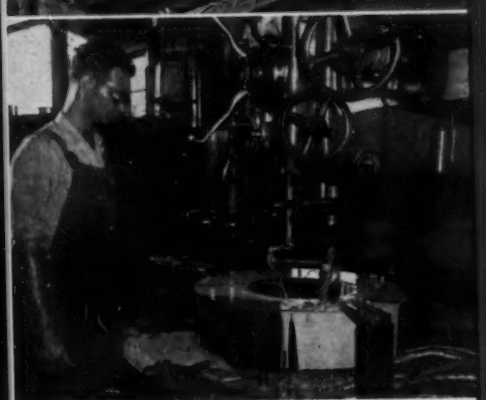

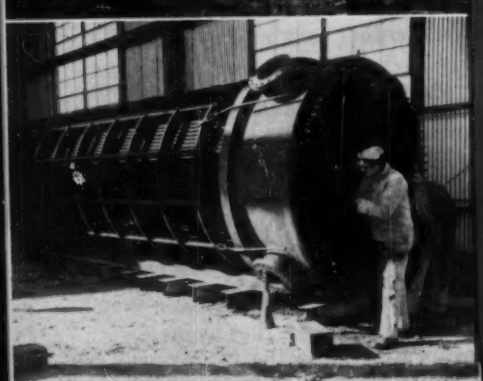

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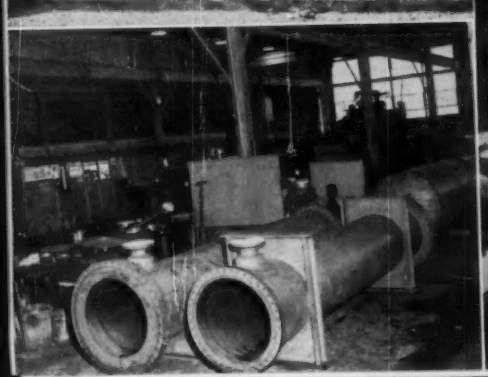
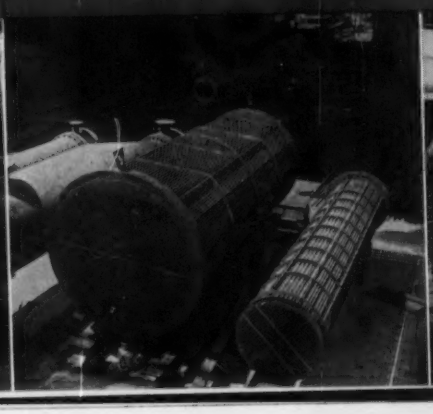
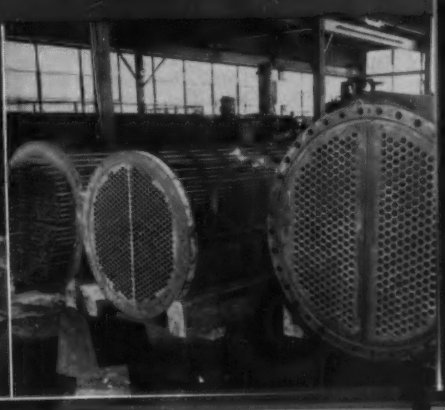
HOUSTON

MAIL ADDRESS: P. O. BOX 7507, HOUSTON 7, TEXAS

Your Inquiries Are Cordially Invited







Who's Building...

expansion and modernization program costing in excess of $1.25 million which will include a new 12,000 b/d topping plant, this unit will substantially increase the company's capacity for producing high octane motor fuels. The unifining unit is scheduled for completion by June 1, 1957.

Tidewater Oil Co. has completed eight buildings, forming an administrative center and laboratories for its new Delaware Flying A refinery, 15 miles south of Wilmington. The eight new buildings include an administration center, two laboratories, a fully equipped firehouse, an industrial relations building, a "change house" for employes, a pilot experimental building and a large maintenance center.

Ammonia Chemical Corp. of California and Monterey Oil Co. will build a $5 million anhydrous ammonia plant at Huron, Calif. Construction is scheduled to start this month with completion slated for about a year later. The plant site is adjacent to the main Texas gas transmission line of Pacific Gas and Electric Co.

Dorchester Corp. will build a combination catformer and unifiner unit with a 1000 b/d capacity at its White Deer, Texas plant. It will upgrade depentanized natural gasoline to 97 octane, and an isopentane blend will bring the octane rating up to 98 plus. The unit is being built by Grebe and Doremus Process Co. of Houston.

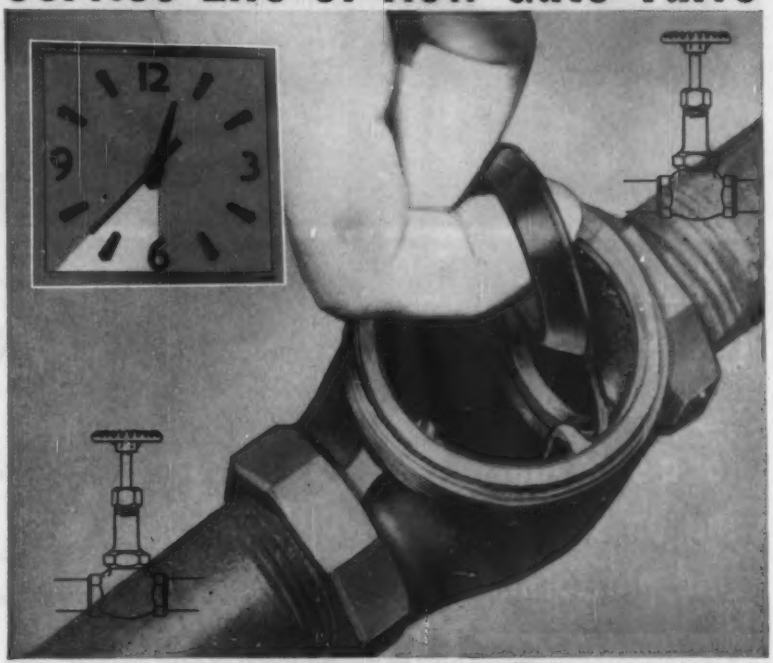
Imperial Oil Co. Ltd., is formulating plans to boost the capacity of its 9200 b/d Calgary refinery to handle a new source of crude. Nothing is certain yet, but the company has applied to the Calgary Technical Planning Board for the purchase of 300 acres adjoining the present refinery.

Shell Co. of Australia Ltd., has placed a new 6700 b/d platformer unit on stream at its 36,000 b/d refinery at Geelong, Australia. Addition of this unit completes the third stage of construction at the refinery and increases the company's capital investment to almost $62 million.

Phillips Petroleum Co. and **Pacific Petroleums Ltd.,** will participate in a $30 million natural gas and refinery project at Taylor, British Columbia, thirteen miles southeast of Fort St. John in the northeast part of the province. First, a $15 million gas scrubbing plant under construction for Westcoast Transmission will remove propane, butane, natural gasoline, and other products from natural gas and will be the initial feed stock for a Phillips-Pacific refinery. Pacific will build basic refining facilities and Phillips will then construct aviation gasoline units. Pacific Petroleum will be the operator of the integrated refinery when it is completed, while sharing interest in it on a 50-50 basis with Phillips. Distillation, catalytic desulphurization and reforming units, dehydrogenation, isomerization, and alkylation units are planned, in addition to loading, blending, and storage facilities.

Ammonia Chemical Corp. of California will build a $5 million anhydrous

Only 7 to 10 Minutes to Renew Service Life of New Gate Valve



Patented development assures replacement of seat ring while valve remains installed.

Without removing the valve body from the line, you replace the nickel-alloy seat rings in Fairbanks new patented Renewable Seat Ring Gate Valves. In 7 to 10 minutes, from the time the line is shut down until it is put back into operation, you have given a new service life, a new life of dependable tight closure to your valve.

Just 7 to 10 minutes of your maintenance man's time — only 7 to 10 minutes of "downtime" on your steam, water or process piping lines — and you have the equivalent of a new valve in the line. Think of the savings: where once at least one hour, under the most ideal conditions, was required to replace a gate valve in the line, the job is now accomplished in from 7 to 10 minutes.

Field tested for over two years, under all conditions from steam to corrosive liquids, the revolutionary new Fairbanks Renewable Seat Ring Bronze Gate Valve has proven completely satisfactory — absolutely dependable.

Made with either rising stem or non-rising stem construction in ½", ¾", 1", 1¼", 1½" and 2" sizes, the Fairbanks Renewable Seat Ring Bronze Gate Valves are recommended for severe service conditions on 200 lb. steam pressure at 550 degrees F., 400 lb. water, oil or gas pressure — non-shock — lines requiring full flow and subject to frequent operation. Nickel alloy seat rings and wedge make the valves particularly tough and corrosion resistant.

YOURS ON REQUEST: Illustrated, descriptive folder gives complete information on Fairbanks Renewable Seat Ring Gate Valve with details and specifications. Yours without charge. Write today.

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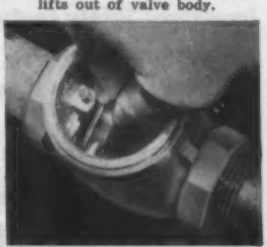
1. Union Bonnet removed. Retaining screw loosened with ordinary screwdriver.

2. Finger hooks inside nickel alloy seat ring. Seat ring lifts out of valve body.



3. New seat ring is inserted. Retaining screw tightened. Bonnet replaced.

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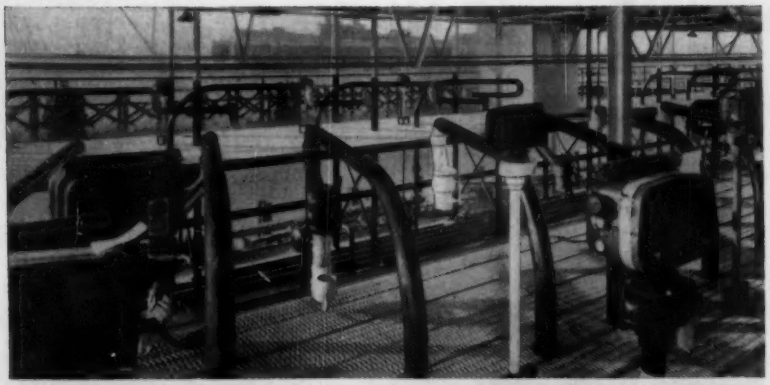
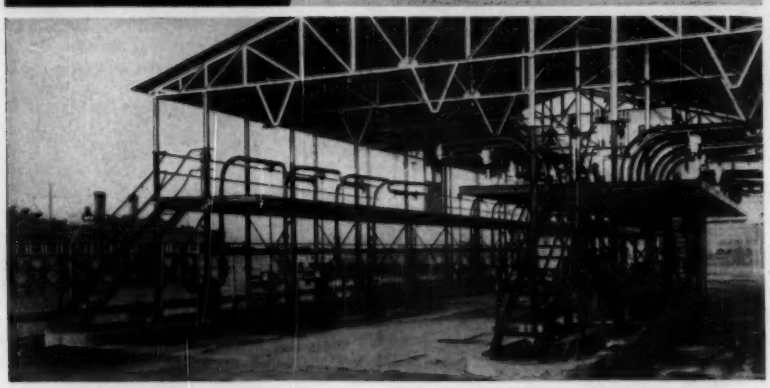
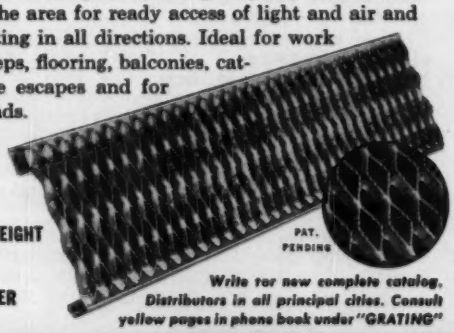




SAFETY GRIP-STRUT is the new basic material, all in one piece (including channels), not welded, riveted or expanded in steel or aluminum, in standard sizes and gauges. Safety GRIP-STRUT presents an open space, in a diamond pattern, in excess of 55% of the area for ready access of light and air and gives a positive NON-SKID footing in all directions. Ideal for work platforms, stair and ladder steps, flooring, balconies, catwalks, machinery guards, fire escapes and for original equipment safety treads.



Important Safety Features

- FIRE PROOF
- SLIP PROOF
- MAXIMUM STRENGTH
- MINIMUM WEIGHT
- EASY TO STAND ON
- COOL IN SUMMER—WARM IN WINTER

Write for new complete catalog. Distributors in all principal cities. Consult yellow pages in phone book under "GRATING"

107

GRIP-STRUT

PRODUCTS DIVISION
The **GLOBE** *Company*
4008 S. PRINCETON AVE., CHICAGO 9, ILL.

Who's Building . . .

ammonia plant near Huron, Calif. The new plant will be financed by Monterrey Oil Co., and at full capacity will use about 5 million cubic feet of gas daily.

American Oil Co.'s new $35 million Yorktown refinery has placed the first of three major producing units on stream.

The first unit to go into production, after years of planning and 16 months of actual construction, was the combination two-stage crude distillation and catalytic cracking unit. This unit also has its integral polymerization and attendant treating facilities.

A second refinery unit, a semi-continuous coking unit, is expected to go on stream in January and the third, an Ultraformer, is expected to be ready in March.

When in full operation, the Yorktown refinery will produce 1,225,000 gallons of gasoline and other petroleum products a day for Amoco customers in Virginia and nearby states.

U. S. Oil & Refining Co. has let the contract for the installation of a catalytic reformer at its refinery at Tacoma, Washington. The unit will be a Houdriformer with a charge capacity of 2500 to 3000 b/d. The contract for engineering and construction was awarded to Holmes and Narver of Los Angeles, and engineering design has already started. Construction is to start early in January with completion set for May, 1957.

Hercules Powder Co., Wilmington, Del., and Imperial Chemical Industries, Ltd., of England have formed a new company to build and operate an $11 million plant for the manufacture of methyl methacrylate. The new company will be called Hawthorne Chemical Corp. and will be owned equally by Hercules and Imperial.

The new plant will have an annual capacity of 35 million pounds and will be built at Louisiana, Mo., adjoining Missouri Ammonia Works, which is owned and operated by Hercules. A major factor in selecting the plant site was the ready availability of key raw materials. Ammonia and methanol will be supplied by Missouri Ammonia Works, and natural gas from the adjacent pipe line from Texas gas fields.

Iraq Government's largest refinery will double in size within the next 30 months. Bids will close on April 1 for construction that will eventually boost capacity of the Daura refinery near Baghdad from 24,000 to 50,000 b/d. Contractors from several countries are studying the job which will probably cost somewhere between $10 and $12 million.

Paragon Oil Co., a distributing company whose main business is fuel oil, will build a new refinery at Tiverton, R. I. Bids are now being taken for the job which will cost between $35 and $40 million. The refinery, which is slated for completion within the next year and a half, is expected to run between 30,000 and 40,000 b/d.

Tidewater Oil Co. has completed construction of the world's largest fluid coking plant. This plant is the third and final major unit completed under the company's

For more data on advertised products, use Readers' Service Cards, last page.

KEEP IT CLEAN... by Phil Tration

Filtering "sound and fury," as shown in the cartoon, is what Walt Disney would call a *plausible impossible* use for Dollinger Filters. In industry today, however, practically any gas, liquid, or air *can* be handled more efficiently with Staynew Filters. They protect machines or processes, or workers from the damage caused by dust, dirt, oil, grease, or other foreign matter. In thousands of industrial and ventilating applications throughout the world, Staynew Filters have become recognized as the highest standard of quality available.

STAYNEW MODEL ELS LIQUID FILTER

The world-wide use of Dollinger filters on hundreds of liquids is proof of their adaptability to practically any requirement. All known filtering materials are available for any problem regardless of temperature, pressure, or efficiency desired. And, all Model ELS Liquid Filter bodies are available in steel, stainless, monel, herculoy and other non-corrosive metals. Construction can be according to ASME Code specifications.

Send for 12-page Bulletin 300. It contains illustrated data and recommended uses of Dollinger Liquid Filters. Dollinger Corporation, 47 Centre Park, Rochester 3, N.Y.

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STAYNEW **DOLLINGER**

FILTERS

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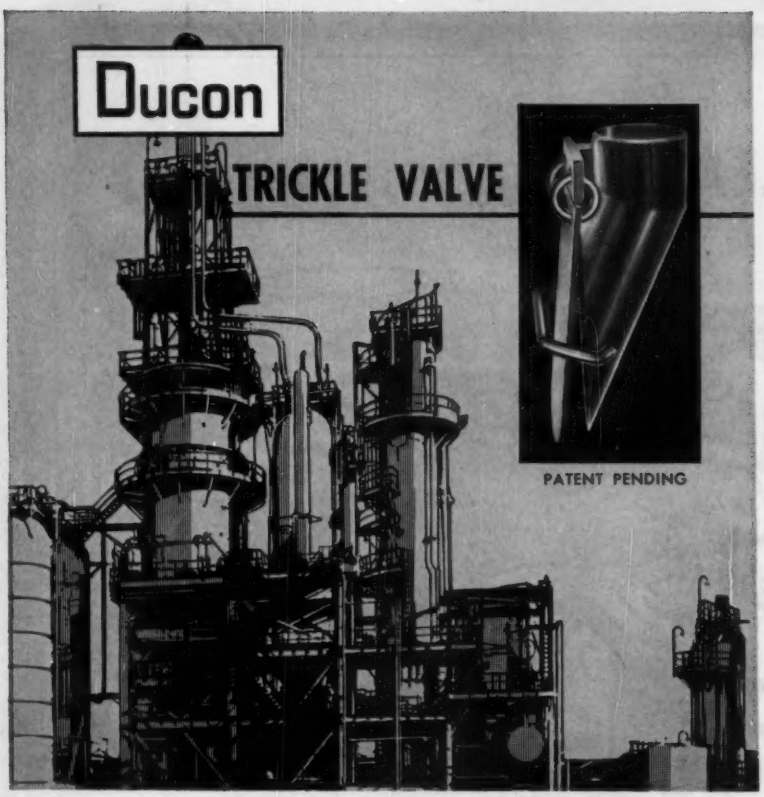

. . . the first dip-leg SEAL with approval for fluid catalytic cracking plants

Ducon's trickle valve has been approved throughout the refining industry, as a "fool-proof" dip-leg seal. Here is the result of years of specialized experience . . . the kind that pioneers progress . . . the kind that has earned for Ducon recognition as a leader in the field of catalyst and fluid solids recovery.

Over 500 trickle valves already in service are proving the effectiveness of the following features:

COMPLETELY AUTOMATIC DIP-LEG SEAL
MINIMUM CATALYST LOSS AT START-UP
ASSURANCE OF DIP-LEG SEAL DURING UPSET
ELIMINATES ALL ADDITIONAL AERATION
MAINTENANCE-FREE CONTINUOUS OPERATION

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CYCLONES • CENTRIFUGAL WASH COLLECTORS • TUBULAR CLOTH FILTERS • DUST VALVES

Who's Building. . .

current expansion program at its Avon Flying A refinery at Associated, Calif. The expansion began in May of last year and is designed to increase the refinery's gasoline and diesel oil making capacity.

Other major units which have been completed in the expansion at Tidewater Oil refinery are a 24,000 b/d hydrodesulfurizer to remove sulfur and nitrogen impurities from partially processed gasoline and an 88,000,000 cubic-foot-a-day gas plant which will extract propane, butane, and gasoline from gas piped from the giant fluid coking plant and three nearby thermal cracking units.

Contractor on the expansion program was the Bechtel Corp.

Standard Oil Co. (Indiana) will build a third ultraformer for making high-octane gasoline at its Whiting, Ind., refinery. The new 21,000 b/d unit is expected to be in operation early in 1958. The unit will increase ultraforming capacity to 56,000 b/d at Whiting, enough to blend about six million gallons of high-octane gasoline daily.

Standard Oil said earlier this year that its Ultraformer program then involved a capital investment of about $61 million, including 13 Ultraformer units. The program is now to be augmented by the new Whiting unit will bring the total number of ultraformers to 14 for the consolidated company.

The new unit supplements a 14,000 b/d ultraformer that began operating this summer and a 21,000 barrel unit under construction and scheduled for completion early in 1957.

Arthur G. McKee Co., Cleveland, Ohio, is the prime contractor for the new unit. Site preparation is under way but no date has been set for starting construction.

Magnolia Petroleum Co. will construct a crude oil distillation unit that will occupy nearly a city block in area and process about 100,000 barrels of crude daily.

John W. Newton, vice president and manager of refining said the unit's lubricant distillate capacity is expected to be the largest of any known unit in the world. It will have twice the processing capacity of any existing unit at Magnolia's 1000 acre Beaumont refinery, and will occupy a plot 390 by 390 feet and rise 166 feet into the air.

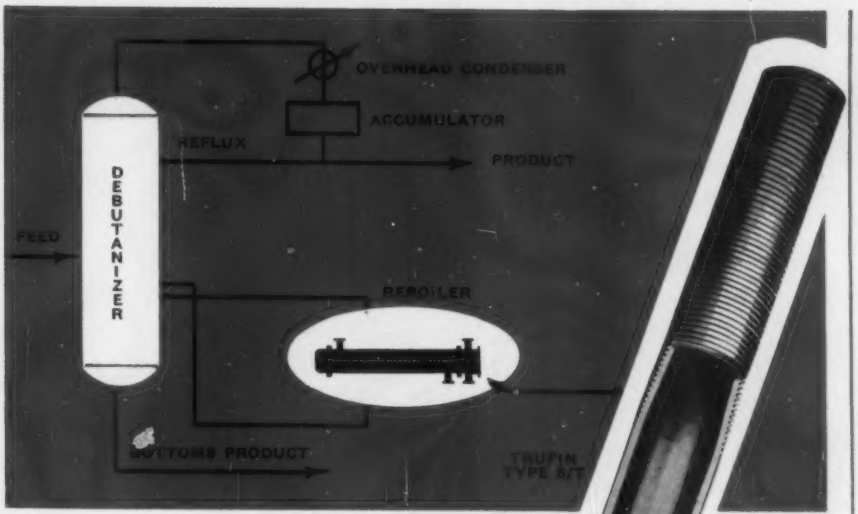
Foster Wheeler Corp. is scheduled to begin construction this spring. It was estimated the unit would be operating by mid-1958.

The new process will eventually replace seven smaller crude units at the plant. Officials said it would not substantially boost the refinery's over-all capacity, which is expected to reach 205,000 barrels daily in early 1957.

Tidewater Oil Co.'s heavy oil unifining unit designed by Universal Oil Products Co. has gone on stream at its Avon, Calif., refinery.

Designed primarily to desulfurize crude naphthas for platforming feed, the 24,000 b/d unit will also handle cracked gas oils and catalytically cracked naphthas. It is Tidewater's second unifining unit at Avon, the first one being used exclusively for feed preparation.

For more data on advertised products, use Readers' Service Cards, last page.



It's Terrific!

ONE TRUFIN-TUBED DEBUTANIZER UNIT REPLACES TWO PLAIN TUBE REBOILERS

By Ernest Dodd

During a recent field trip I ran into an interesting heat transfer story. It has its setting in a large Midwest refinery and—after the facts had been assembled—here's the way it added up.

To obtain a heat duty of 2,382,000 BTU's per hour the refinery engineers had on stream two reboilers—one tubed with 407-¾" O.D. x 14 BWG x 16' long electric-welded steel tubes—the other with 348 similar tubes.

Now don't mistake me. There was nothing basically wrong with this installation. It was doing a good job and the engineers were happy with it—happy, that is, until they listened to a Wolverine technical sales representative who appeared on the scene just as the 348-tube unit came off stream for retubing. The man from Wolverine told his story and things will never again be the same around that refinery. Here's why!

The off-stream unit was retubed with 348 lengths of electric-welded steel Wolverine Trufin® Type S/T—the integral finned condenser tube. Because of the integral fins, Trufin Type S/T has double the heat transfer surface of plain tube. In addition to extracting more BTU's per foot of tube it also packs more heat transfer surface into a given area.

Because of this, *the single Trufin-tubed reboiler is carrying as much heat load as that formerly handled by the two prime surface units.* In the bargain the refinery engineers recently increased throughput in the column and the Trufin-tubed unit is still able to deliver the required heat duty.

There's a moral to this heat transfer story and it isn't hard to find: consult Wolverine's Field Engineering Service if you're looking for increased heat transfer performance. You'll boost production, cut costs, do a better all around job.

INTEGRAL DESIGN HELPS TRUFIN FIGHT VIBRATION

The fins of Wolverine Trufin are integral—squeezed directly from the tube wall. As a result there is no possibility of a "fin joint efficiency loss" because of vibration, thermal shock or varying pressures. The fins of Wolverine Trufin remain constant during the life of the tube.

In addition, the heavier gauge of the end section and the standard gauge of the finned tube results in a short length of tapered wall thickness and inside diameter. Because of this, the Trufin tube gives maximum rigidity at the end section where service stresses tend to concentrate. The smooth, gradual taper on the inside diameter has the additional feature of lessening turbulence which also helps increase Trufin's life expectancy.

Cuts Structural Weight

Because Wolverine Trufin packs more heat transfer surface in a given area it permits the design of smaller heat exchangers and condensers. As a result, where overhead units are used, the more compact, more powerful Trufin units require less structural support—a feature which often means substantial savings.

SEND FOR FREE BOOK

Probably the most comprehensive source of information available anywhere on finned condenser tubes is to be found in Wolverine's Trufin Opportunity Book. Here engineers will find valuable design information, fouling data and applications as well as many actual case studies. This book is yours absolutely—FREE! Write for your copy—TODAY!

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CALUMET & HECLA OF CANADA LIMITED
CANADA VULCANIZER AND EQUIPMENT COMPANY LIMITED

WOLVERINE TUBE

Division of Calumet & Hecla, Inc.

1437 CENTRAL AVENUE, DETROIT 9, MICHIGAN

Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA.
SALES OFFICES IN PRINCIPAL CITIES.

EXPORT DEPT., 13 E. 40TH ST., NEW YORK 16, N.Y.

5704 571W1

Wolverine Trufin available in Canada through the Unifin Tube Company, London, Ontario

TUBULAR TIME SAVER

Saving time is important—it is directly reflected in both output and financial earnings.

You can save time—lots of it—by using prefabricated Wolverine U-Bend condenser tubes in either finned (Wolverine Trufin®) or prime surface form.

Wolverine bends condenser tubes to your specifications—ships them in disposable box-type pallets in the exact order of their installation—ready for direct insertion into your heat exchanger or condenser.

In addition to assembly time, you eliminate the transportation, space and handling headaches present when dealing with tubes over 30 feet long. One tube sheet is eliminated and floating head problems are reduced. Rolling in operations are cut in half.

Wolverine prime surface tube U-Bends are available in a wide range of sizes and alloys in copper, copper-base alloys and aluminum. Capacity boosting Trufin U-Bends are available in copper, copper-base alloys, aluminum and electric-welded steel. Complete information is contained in Wolverine's Condenser Tube Catalog. Write today.

CALUMET & HECLA, INC.
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WOLVERINE TUBE

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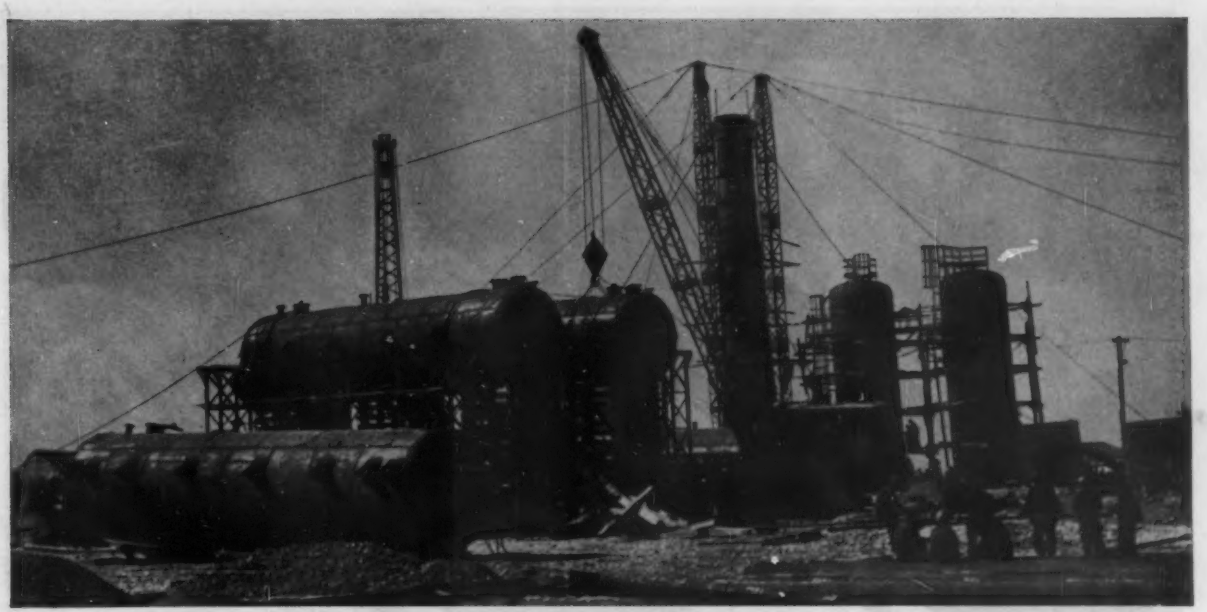
EXPORT DEPT., 13 E. 40TH ST., NEW YORK 16, N.Y.

9784 571W1



Eastfoto

'Modernizing' Communist Refining

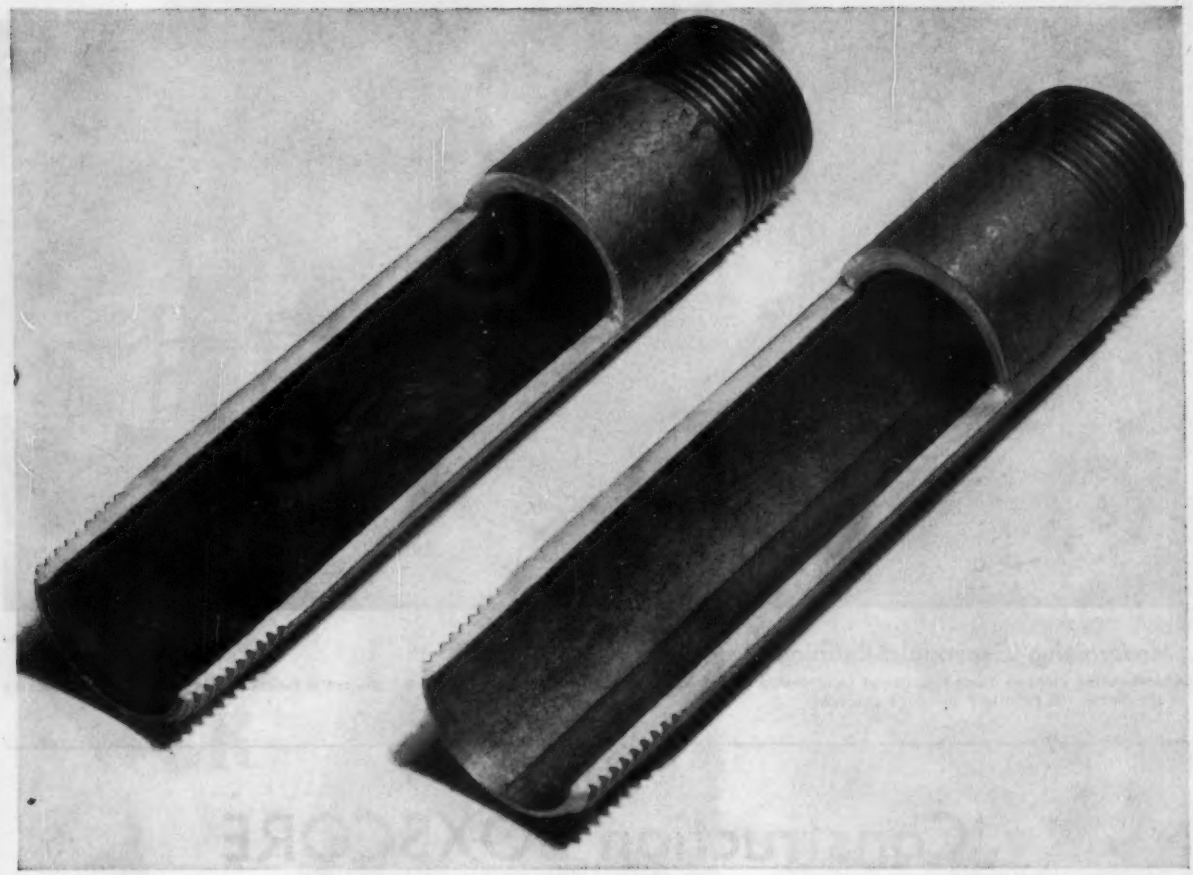
A new coking plant in Yumen oil center in northwest China will soon go into operation. When this project is finished, charge for thermal cracking in the Yumen oil field will go up 14 percent.

Construction BOXSCORE

REFINERIES, NATURAL GASOLINE AND PETROCHEMICAL PLANTS

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licenser	Engineering	Contractor
EAST									
Allied Chemical Dye	Elizabeth, N.J.	Sulfuric Acid	.....	.....	Planning	.....	.....	.....	.....
American Cyanamid	Northern Florida	Acrylic Fiber	27,000,000 bbls/yr.	.....	Planning	1958	.....	.....	.....
American Oil Co.	Yorktown, Va.	Refinery: Two-Stage Distillation; Cat Crk.; Polymerisation; Hydrodesulfurisation; Coking; Ultraforming	35,000 bbls.	$30,000,000	Complete	.....	Std. (Ind.)	Kellogg, Lummus, Parsons	Kellogg, Lummus, Parsons, CB&I
American Oil Co.	Yorktown, Va.	Crude Distillation for Asphalt	25,000 bbls	.....	.....	Early 1956	.....	.....	.....
American Synthetic Rubber	Louisville, Ky.	Exp. Copolymer Plt.	To 68,000 tons/yr.	$3,000,000	Under Constr.	1st. Qtr. 1957	.....	Kidde	Kidde
*Ashland Refining	Ashland, Ky.	Lube Oil Compounding Bldg.	.....	$175,000	.....	June, 1957	.....	.....	.....
Atlantic Refining	Philadelphia	Cat. Reforming Inc. Ammonia Cap.	15,000 bbls. †75 tons	Part of $11,000,000 Program	Engineering Engineering	Mid 1957	Atlantic	Blaw Knox	Blaw Knox
Borden	Fayetteville, N.C.	Formaldehyde	36,000,000 lbs./yr.	.....	Complete	.....	.....	.....	.....
California Oil	Perth Amboy, N.J.	Ine Reforming	12,500 bbls.	.....	Complete	.....	.....	Bechtel	Bechtel
Cary Chemicals	Flemingdon, N.J.	PVC Resin Plt.	.....	.....	Under Constr.	.....	.....	.....	.....
Commerce Oil Ref.	Portsmouth, R.I.	Refinery, Cat. Cracking Crude Units	30,000 bbls. 25,000 bbls. 40,000 bbls.	$30,000,000	Planning	1957	.....	Lummus	.....
*Delta Refining Co.	Memphis, Tenn.	Girbotol Unit	1,500 bbls.	.....	Under Constr.	Early, 1957	.....	Girdler	Girdler
Escambia Bay Chemical	Pensacola, Fla.	Polyvinyl-Chloride Resin	30,000,000 lbs./yr.	.....	Complete	.....	.....	Blaw Knox	Blaw Knox
*Escambia Bay Chemical	Pensacola, Fla.	Methanol	18,000,000 gal./yr.	.....	Under Constr.	4th Qtr., 1957	.....	.....	.....
Esso Standard	Everett, Mass.	Powerformer	7,200 bbls.	.....	Under Constr.	Mid 1957	Esso	Badger	Badger
Esso Standard	Linden, N.J.	Ethylene Plt.	.....	.....	Under Constr.	.....	.....	S&W Badger Div.	S&W Badger Div.
Esso Standard	Linden, N.J.	Powerformer	20,000 bbls.	.....	Under Constr.	Mid 1957	Esso	Foster Wheeler	Foster Wheeler
Frontier Oil Refining	Tonawanda, N.Y.	Cat. Reformer Hydro. Trter	6,000 bbls.	$2,000,000	Complete	.....	.....	Foster Wheeler	Foster Wheeler
Frontier Refinery	Fort Pierce, Fla.	Refinery	15,000 bbls.	$16,000,000	Planning	.....	U.O.P.	Ebasco	.....
*Frontier Refining	Tonowanda, New York	Aromatics Plts.	21,000,000 gal./yr.	$3,000,000	Engineering	Late, 1957	UOP	.....	.....

Construction Box Score Continued on Page 235



CORROSION PREVENTED

with SOLVAY SODIUM NITRITE

With a low and *economical* concentration of Solvay® Sodium Nitrite you can prevent corrosion in circulating water systems, on metal parts in process and on raw sheets, tubes or bars in storage. The corrosive attack on the pipe at the left, above, is the result of plain water. The pipe on the right was subjected to identical conditions except that the water contained 500 ppm of sodium nitrite.

Solvay Sodium Nitrite works to halt or prevent corrosion by forming an invisible oxide coating on metal surfaces. It is effective with iron and steel and has been reported to suppress the degradation of aluminum, tin, monel, copper and brass. It is non-toxic in the concentrations normally used to prevent corrosion.

Our booklet, "Sodium Nitrite for Rust and Corrosion Prevention," gives details on how sodium nitrite, alone or in combination with other materials, prevents corrosion in a wide variety of applications. Write for your free* copy today.

*In western hemisphere countries only.

SOLVAY®

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Soda Ash • Snowflake® Crystals • Potassium Carbonate • Calcium Chloride • Ammonium Bicarbonate • Sodium Bicarbonate • Cleaning Compounds
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Monochlorobenzene • Carbon Tetrachloride • Chloroform • Methylene Chloride • Hydrogen Peroxide

For more data on advertised products, use Readers' Service Cards, last page.

REFINER AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
General Aniline & Film	Linden, N.J.	Ethylene Oxide; Ethylene Glycol	.....	$8,000,000	Under Constr.	1957	SDC	SDC	SDC
*Goodrich Chemical Co.	Calvert City, Ky.	Acrylic Polymers	.....	$2,500,000	Under Constr.	Late, 1957	.....	.....	Wigton-Abbitt
Goodrich-Gulf	Institute, W. Va.	Boiler House	.....	$1,500,000	Planning	.....	.....	.....	.....
Gulf Oil	Philadelphia	Cat. Reforming	24,000 bbls.	.....	Engineering	Mid 1957	UOP	Procon	Procon
		LPG	1,000 bbls.	.....	Complete	.....	.....	Staff	Staff
		Alkylation	2,800 bbls.	.....	Under Constr.	2nd Qtr. 1957	.....	Parsons	Parsons
Gulf Oil	Philadelphia	Gulfining	36,000 bbls.	.....	Under Constr.	Early, 1957	Gulf	Gulf, Kellogg	Kellogg
*Gulf Oil	Near Charleston, S. C.	Refinery	.....	.....	Planning	.....	.....	.....	.....
Hercules Powder	Parlin, N.J.	Polyethylene	30,000,000 lbs./yr.	$10,000,000	Under Constr.	.....	.....	.....	.....
Heyden Chemical	Fords, N.J.	Pentaerythritol	25,000,000 lbs./yr.	.....	Under Constr.	March, 1957	.....	Staff	.....
Kentucky Hydro-carbon	Maytown, Ky.	Ethane Plt.	50 Mmcf	.....	Designing	Early 1957	.....	.....	.....
Koppers	Woodbridge, N.J.	Polyethylene	30,000,000 lbs./yr.	.....	Under Constr.	Early 1957	Koppers	Koppers	Koppers
Koppers	Monaca, Pa.	Polystyrene	.....	.....	Complete	.....	Koppers	Koppers	Koppers
*Koppers	Kobuta, Pa	Polystyrene	.....	.....	Under Constr	Early, 1958	.....	Staff	Staff
*Metal Hydrides	Danvers, Mass.	Hydrogen Plt.	.....	.....	Engineering	.....	.....	Girdler	Girdler
*Paragon Oil Co.	Tiverton, R.I.	Refinery	30,000 bbls.	$35,000,000	Planning	.....	.....	.....	.....
Pennsalt	Calvert City, Ky.	Organic-Fluorine	.....	.....	Planning	.....	.....	.....	.....
Pontiac Eastern Corp	Hattiesburg, Miss.	Refinery	12,000 bbls.	$18,000,000	Under Constr.	May, 1957	U.O.P.	Fluor	Fluor
Reichhold Chemical	Tuscaloosa, Ala.	Sulfuric Acid Plt.	100 tons/day	$1,000,000	Planning	.....	.....	.....	.....
*Rhode Island Ref.	Tiverton, R.I.	.....	.....	.....	Planning	.....	.....	.....	.....
Socony Mobil	Paulsboro, N.J.	Hydrodesulfurization	22,000 bbls.	.....	Under Constr.	July, 1957	.....	Foster Wheeler	Foster Wheeler
Socony Mobil	Brooklyn	Sovaformer	.....	.....	Complete	.....	.....	Bechtel	Bechtel
*Socony Mobil	Buffalo, N.Y.	Alkylation	2,440 bbls.	.....	Engineering	Sept., 1957	.....	Kellogg	Kellogg
Southern Nitrogen	Savannah, Ga.	Ammonia, Nitric Acid, Nitrogen Solutions, Ammonium Nitrate, Urea	250 ton	$14,000,000	Complete	.....	.....	Girdler	Girdler
*Spencer Chemical	Henderson, Ky.	Poly-carprolactum (Nylon) Plt.	.....	.....	Under Constr.	Summer, 1957	A.K.U., Arnhem	Staff	Quaker
Stauffer Chemical	Louisville, Ky.	Carbon Tetrachloride, Chloroform, Methylene Chloride, Hydrogen Chloride	.....	.....	Under Constr.	1957	.....	.....	.....
The Southland Co.	Tampa	Refinery	15,000 bbls.	$12,000,000	Planning	.....	.....	.....	.....
The Texas Co.	Westville, N.J.	Vis-Breaker	13,300 bbls.	$1,300,000	Complete	.....	.....	Treco	Treco
		Inc. FCC Cap.	6,500 bbls.	.....	Complete	.....	.....	.....	.....
		Inc. Vacuum Pipe Shell Cap.	10,000 bbls.	$1,000,000	Complete	.....	.....	Staff	Catalytic
Thompson Chem.	North Dighton, Mass.	Polyvinyl Chloride Plt.	.....	.....	Planning	.....	SDC	SDC	.....
Tide Water Oil	Wilmington, Del.	Refinery	130,000 bbls	$100,000,000	Under Constr.	1957	.....	Braun, Kellogg	.....
United Refining	Warren, Pa.	FCC Gas Recovery; Cat Poly; Treating	2,500 bbls.	$200,000	Under Constr.	Jan., 1957	.....	Procon	Procon
MID-CONTINENT									
Allied Chemical & Dye	Toledo, Ohio	Polyester	.....	.....	Engineering	.....	.....	Catalytic	Catalytic
*Amoco Chemical Corp.	Midwest	Phthalic Anhydride Isophthalic Acid, Terephthalic Acid, Dimethyl Terephthalate, Dimethyl Isophthalate Benzoic Acid	60,000,000 lbs./yr.	$10,000,000	Engineering	1958	.....	.....	.....
Anderson-Prichard	Cyril, Okla.	Cat. Crker, Fractionation; Light-Ends Recovery; Revamping	5,000 bbls.	.....	Under Constr.	March, 1957	UOP	Procon	Procon
*Anderson-Prichard	Oklahoma City	Propane Deasphalting Unit	3,000 bbls.	.....	Under Constr.	Late, 1957	Esso	Badger Mfg.	Badger Mfg.
*Ashland Refining	Canton, Ohio	Cat Reformer	6 000 bbls.	$2,400,000	Under Constr.	June, 1957	.....	Blaw-Knox	Blaw-Knox
		Hydrogen Trter							
*Ashland Refining	Canton, Ohio	Vacuum Tower	15,000 bbls.	$1,200,000	Engineering	Oct., 1957	.....	Blaw-Knox	Blaw-Knox
*Aurora Gasoline Co.	Detroit, Mich.	Fluid Coker	4,000 bbls.	.....	Under Constr.	.....	Esso	Parsons	Parsons
*Aurora Gasoline Co.	Muskegon, Mich.	Vac. Cap.	6,000 bbls.	.....	Under Constr.	March, 1957	.....	.....	.....
*Ben Franklin Ref. Co.	Ardmore, Okla.	FCC Cap.	500 bbls.	.....	.....	1957	UOP	UOP	Staff
Calumet Nitrogen Products Co.	Hammond, Ind.	Ammonia Nitrogen Fertilizer	300 Tons	.....	Complete	.....	.....	Fluor	Fluor
Century Refining	Garden City, Kans.	Cat Reformer	500 bbls.	$150,000	Engineering	1957	UOP	Litwin	Staff
Cities Service	Ponca City, Okla	Rexformer	6,000 bbls.	.....	Engineering	1957	UOP	UOP	Procon
Cities Service Oil	Ponca City, Okla.	Increase Ref.	10,000 bbls.	$2,000,000	Engineering	May, 1957	UOP	UOP	.....
Clark Oil & Ref.	Chicago	Refinery Expansion	9,000 bbls.	.....	.....	.....	.....	.....	.....
		Vacuum Unit	.....	.....	.....	.....	.....	UOP	CBI
		Crude Heater	.....	$5,000,000	Planning	1958	.....	.....	.....
		Alkylation	.....	.....	.....	.....	UOP	.....	.....
		Gas Recovery	.....	.....	.....	.....	UOP	.....	.....
		Cat Cracker	.....	.....	.....	.....	UOP	.....	.....
*Commercial Solvents & Columbus Gas	Ohio Valley	Petrochemical Plt.	.....	$40,000,000	Planning	.....	.....	.....	.....
Continental Oil	Ponca City	Cat Reformer	11,000 bbls.	$3,000,000	Under Constr.	Mid 1957	.....	Kellogg	Kellogg
Derby Refining	Wichita, Kans.	Exp. Ultraformer	4,000 bbls.	$600,000	Completing	.....	Standard-Ind.	.....	Pritchard
Dow Chemical	Ironton, Ohio	Polystyrene Plts.	.....	.....	Complete	.....	.....	.....	.....
*Dow Chemical	Bay City, Mich.	Ethylene Plt.	.....	.....	Engineering	Jan., 1958	.....	.....	.....
D-X Sunray	Duncan, Okla.	Inc. Cat. Reformer	†3,000 bbls.		Under Constr.	Late 1957	.....	Treco	Treco
		Unifining	6,000 bbls.						
		Platformer	12,000 bbls.						
	Tulsa	Unifining	20,000	$10,000,000					
		HF Alkylation	2,500 bbls.		Under Constr.	Late 1957	.....	Treco	Treco
		Butane-Isomerisation	2,500 bbls.						

Construction Box Score Continued on Page 239

I had maintenance headaches . . .

THIS astute petroleum engineer solved his maintenance problems when he discovered that:

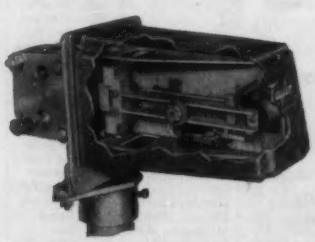
Taylor TRANSAIRE* Transmitters for temperature, pressure and flow need minimum maintenance to give dependable accuracy—continuously—under the most rugged conditions found in the petroleum industry!

Taylor TRANSAIRE Transmitters give more sensitive measuring—faster. Designed in close collaboration with processing engineers, these Transmitters are made to meet today's industrial requirements for precision instruments that practically take care of themselves.

Here are the three members of the TRANSAIRE family that one user called "the perfect prescriptions for maintenance problems." All have weatherproof housings built for tough service and outdoor mounting—all have negligible motion for the least possible wear. Ask your Taylor Field Engineer for full details of these field-proven Taylor TRANSAIRE Transmitters, or write for **Bulletin 98226.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

*Reg. U.S. Pat. Off.

By Taylor TRANSAIRE Differential Pressure Transmitter

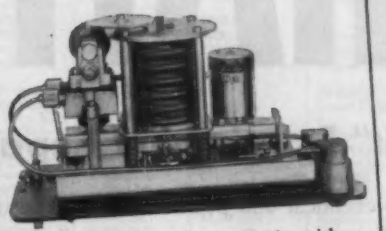


A very versatile flow transmitter, inexpensive and simple to install . . . easy to maintain. Quick, simple range changes for product or seasonal demand changes. Follows flow changes quickly because of low volumetric displacement—no seal pots. Self-draining or venting—no periodic manual venting or draining of lead lines. Overrange protection to full body rating. Easy range suppression. Negligible temperature effect. No leveling—mercuryless dry meter. Simplified piping because it can be close-coupled to orifice flanges.

Taylor Instruments

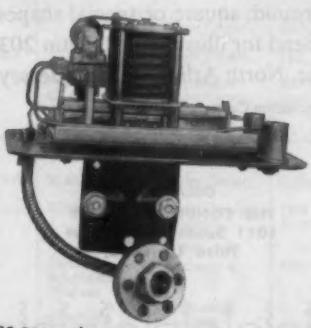
until I found TAYLOR!

Ry Taylor TRANSAIRE
Temperature Transmitter



Speed-Act derivative response in measuring circuit gives true dynamic accuracy. This is a compact, super-responsive instrument designed to measure and transmit smallest temperature changes up to 1000 ft. with great accuracy. It will transmit an output pressure proportional to the measured temperature with an accuracy of plus or minus 0.006 psi. Many short range spans within limits of minus 375°F. to plus 1000°F. So simple to maintain that some plants we know have forgotten where they're installed!

Ry Taylor TRANSAIRE
Pressure Transmitter



To measure and transmit suppressed pressure changes up to 1000 ft. Accurate to ½% of selected short range span, sensitive to pressure change of ½" water. Short range spans of 20 and 40 psi. throughout range limits of 35 to 415 psia, and 50 and 100 psi. throughout 100 to 1,000 psia. Volumetric type pressure system is extremely accurate, practically clog-proof, has corrosion resistant 316 stainless steel diaphragm. Temperature and barometric compensation for higher accuracy of measurement and control.

MEAN ACCURACY FIRST

For more data on advertised products, use Readers' Service Cards, last page.

get cleaner

more economical liquid/vapor

SEPARATION

with "Schuylernit" Entrainment Separators

Stop costly liquid loss . . . in chemical and petroleum process equipment at lower cost with "Schuylernit" Entrainment Separators (mist eliminators). Specifically designed and constructed to separate liquid and small solid particles from any gas or vapor, "Schuylernit" Entrainment Separators assure these advantages: Elimination of liquid loss . . . increased throughput . . . improved process efficiency . . . reduced vessel sizes . . . reduced contamination . . . improved product quality.

- **"Schuylernit" Entrainment Separators are highly recommended for:** Vacuum and flash towers, gas absorbers, evaporators, distillation equipment, knock-out drums, steam drums, scrubbers, gas filters, compressors.

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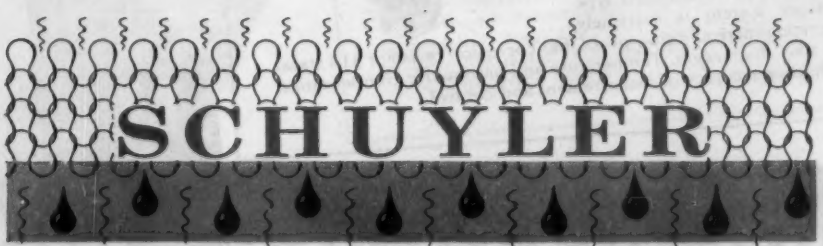

MANUFACTURING CORP., NO. ARLINGTON, N. J.

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Firestone Tire	Akron, Ohio	Expand Syn. Rubber Plt.	†35 percent		Planning				
Goodrich Chemical	Avon Lake, Ohio	Add. Polyvinyl Resins, Plastic Compounds		$8,000,000	Under Constr.	March, 1957		Girdler	Girdler
Goodyear Synthetic Rubber	Akron, Ohio	Copolymer Exp.	27,000 tons/yr.	$2,500,000	Under Constr.	June, 1957		Staff	Carmichael
*Great Northern Oil Company	Pine Bend, Minn.	Catalytic Desulfurization	8.2 MMSCFD	$1,000,000	Complete	Dec., 1956		Fluor	Fluor
*Hawthorne Chemical Co.	Louisiana, Mo.	Methyl, Methacrylate Plt.	35,000,000 lbs./yr.	$11,000,000	Engineering				
Hercules Powder	Louisiana, Mo.	Formaldehyde Plt.	100,000,000 lbs./yr.		Under Constr.	1957			
		Pentaerythritol Plt.	24,000,000 lbs./yr.		Under Constr.	1957			
Hercules Powder	Louisiana, Mo.	Methanol Plt.	7,000,000 gal./yr.	$2,000,000	Under Constr.	Mid 1957	Vulcan	Vulcan	Vulcan
Indiana Farm Bureau Coop	Mt. Vernon, Ind.	Steam Generation	120,000 lbs./hr.	$350,000	Complete			Sweco	Sweco
International Refineries	Wrenschall, Minn.	Cat. Reformer	2,800 bbls.	$1,500,000	Complete		Esso	Parsons	Parsons
Leonard Refineries	Alma, Mich.	Cap. Increase	14,000 bbls.		Complete				
Leonard Refineries	Alma, Mich.	Ultraformer	3,600 bbls.		Complete		Std. (Ind.)	Parsons	Parsons
		Hydrofiner	5,200 bbls.		Under Constr.		Std. (N.J.)	Pritchard	Pritchard
*Lion Oil Co.	El Dorado, Ark.	Nitric Acid Concentrator	40 tons		Under Constr.				C&I
Naph-Sol Refining Co.	Muskegon, Mich.	Cat. Reformer	6,000 bbls.		Planned				
National Cooperatives	McPherson, Kans.	Alkylation	1400 bbls.	$1,200,000	Complete		UOP	Treco	Treco
National Petrochemical	Tuscola, Ill.	Mod. Ethylene Unit			Complete			S&W Badger Div.	
Northwestern Ref. Co.	St. Paul Park, Minn.	Cat. Reformer	6000	$2,500,000	Planning	Jan., 1958			
Olin Mathieson	Olin, Ind.	Cellophane Plt.							
Pan-Am Southern Corp.	El Dorado, Ark.	Ultraformer	6,200 bbl.		Under Constr.	July, 1957	Standard, Indiana	Lummus	Lummus
Pana Refining Co.	Pana, Ill.	Modernization	†1,600 bbls.	$900,000					
Petroleum Specialties	Flat Rock, Mich.	Visbreaker	3,000 bbls.	$250,000	Planning			Litwin	
Prime Oil Co.	Calumet City, Ill.	Refinery	15,000 bbls.	$10,000,000	Planned				
Procter & Gamble	Kansas City, Kan.	Hydrogen Plt.			Engineering	1957		Girdler	Girdler
The Pure Oil Co.	Lemont, Ill.	Cat. Reformer	12,000 bbls.		Planning	Mid 1957		Kellogg	Kellogg
The Pure Oil Co.	Lemont, Ill.	Cat Reformer	12,000 bbls.		Under Constr.	Fall, 1957		Kellogg	Kellogg
		Feed Prep. Unit	17,000 bbls.						
R&J O&R	Princeton, Ind.	Thermal Poly	1800 bbls.		Complete			UOP	
Sinclair Refining	East Chicago	Hydrofinishing		$1,300,000	Under Constr.			Treco	Treco
*Sinclair Refining	Wood River, Ill.	Cat. Reformer	6,500 bbls.	$7,000,000	Under Constr.			McKee	McKee
Socony Mobil	East St. Louis	Sovaformer	12,000 bbls.		Planning	1957		Fluor	Fluor
		Pretreater	16,000 bbls.		Planning	1957		Fluor	Fluor
*Socony Mobil	Augusta, Kans.	Cat. Reformer	9,000 bbls.		Under Constr.	Aug., 1957		Pritchard	Pritchard
*Socony Mobil	Trenton, Mich.	Alkylation Unit	3,500 bbls.	$3,500,000	Engineering	Early, 1958		Fluor	Fluor
Standard-Indiana	Whiting, Ind.	Ultraformer	21,000 bbls.		Under Constr.	Early 1957	Std. (Ind.)	Parsons	Parsons
Standard-Indiana	Wood River, Ill.	Coking Unit	8,500 bbls.		Planning	1957			
Standard-Indiana	Sugar Creek, Mo.	Alkylation	3,800 bbls.		Under Constr.	Mid, 1957		Foster Wheeler	Foster Wheeler
Standard-Indiana	Whiting, Ind.	Rehabilitation			Under Constr.	Early 1957			
*Standard-Indiana	Whiting, Ind.	Ultraformer	21,000 bbls.		Engineering	1958	Standard (Ind.)	McKee	McKee
*Standard-Indiana	Whiting	Ultraformer III	21,600 bbls.		Under Constr.	1958		McKee	McKee
*Standard-Indiana	Neodesha, Kans.	Ultraformer	6,000 bbls.		Engineering	Early, 1958	Standard (Ind.)	Foster Wheeler	Foster Wheeler
Standard (Ohio)	Toledo, Ohio	Refinery Exp.	†60,000 bbls.	$40,000,000	Engineering	Mid, 1958		Kellogg	Kellogg
Standard (Ohio)	Elmore, Okla.	Exp. Gasoline Plt.	†2k Mmcf		Under Constr.				
Standard (Ohio)	Cleveland, Ohio	Alkylation	3,000 bbl.	$3,000,000	Planning	Early 1958			McKee Co.
*Sunray Mid-Continent Oil	Near Carnex, Okla.	Gaso. Products Field Plt.	17¼ million cu. ft.		Engineering				Tuloma
The Texas Co.	Lawrenceville, Ill.	Inc. Vacuum Pipe Still Cap.	8,500 bbls.		Complete				
		Inc. FCC Cap.	2,000 bbls.		Under Constr.				
The Texas Co.	Lockport, Ill.	Convert Hydroformer +0 Platformer	10,000 bbls.		Under Constr.	Fall, 1957		UOP	Staff
*The Texas Co.	Lockport, Ill.	Ammonia Plt.	180 tons		Under Constr.	4th Qtr., 1957		Foster Wheeler, C&I	Foster Wheeler, C&I
U. S. I. C.	Tuscola, Ill.	Isomer of Sebacic Acid	10,000,000 lb./yr.		Under Constr.	July, 1957			
Vickers Petroleum	Potwin, Kans.	Ultraformer	2,500 bbls.	$1,000,000	Engineering	Spring, 1957	Standard-Ind.	Parsons	Parsons
*Westland Oil Co.	Williston, N.D.	Inc. Platformer	to 530 bbls.	$214,000	Under Constr.	April, 1957		UOP	
Wisconsin Oil Refining Co.	Sheboygan, Wis.	Vacuum Unit	2,500 bbls.		Planning			Koch	
SOUTHWEST									
*Aluminum Co. of America	Point Comfort, Texas	Gas Processing Plt.	100 MMSCFD	$1,500,000	Under Constr.	Spring, 1957		Pregle, Dukler & Crump	Staff
American Cyanamid	Avondale, La.	Acrylonitrile PH		$25,000,000	Under Constr.	1958			
American Oil	Texas City	Ultraformer & Desulfurization Unit	21,000 bbls.		Engneering	Early 1958		Parsons	Parsons
Atlantic Refining	Pt. Arthur, Tex.	Catformer	15,000 bbls.	Part of $11,500,000 Program	Engineering	Mid 1957	Atlantic	Blaw-Knox	Blaw-Knox
Atlantic Refining	Crane, Texas	Gasoline Plt.	25 Mmcf		Engineering				
Bureau-Mines	Exell, Texas	Helium Plt.		$6,000,000	Planning			Stearns-Rogers Bureau-Mines	
Carbide & Carbon	Seadrift, Texas	Ethylene Oxide Exp.	To 200,000,000 lbs./yr.		Planning				
Carbide & Carbon	Seadrift, Texas	Inc. Ethylene Glycol Cap.	To 65,000,000 lbs./yr.		Planning				
Celanese	Houston	Polyolefin Refin	40,000,000 lbs./yr.		Under Constr.	1957	Phillips	Braun	Braun
Celanese	Bishop, Texas	Plt. Expan.	25 Percent		Under Constr.				
*Celanese	Pampa, Texas	Acrylate Ester Plt.	15,000,000 lbs./yr.		Under Constr.	Late, 1957			
Chemol Corp.	New Orleans	Refinery	20,000 bbls.	$20,000,000	Planning				
Cities Service, et al.	Midland, Texas	Nat. Gaso. Plt.	50 Mmcf		Under Constr.	March, 1957		Delta	Delta
*Commercial Solvents	Sterlington, La.	Methanol Ammonium Nitrate		$8,000,000	Under Constr.	July, 1957		Ford, Bacon, Davis: Staff	Ford, Bacon, Davis
Corpus Christi Refg.	Corpus Christi	Reformer	15,000 bbls.		Under Constr.	Early 1957	UOP	Treco	Treco
Cosden Pet.	Big Spring, Tex.	Revamp Cat. Cracker	13,000 bbls.	$750,000	Complete		UOP	Cosden	Cosden
		Styrene Plt.	20,000,000 lbs./yr.	$750,000	Under Constr.	Feb., 1957		Badger Mfg.	Badger Mfg.

Construction Box Score Continued on Page 241

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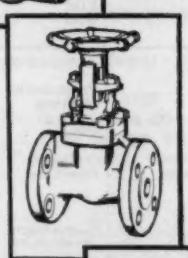
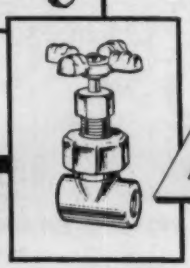


FLANGED END GATE VALVES



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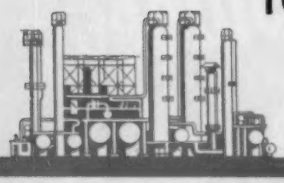
REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Corpus Christi Refining Co.	Corpus Christi, Texas	Modernization & Expansion	†3,000 bbls.	$1,200,000	Under Constr.	.....	.....	.....	.....
Delhi-Taylor Oil.....	Corpus Christi	Unifining Platforming	14,000 bbls.	.....	Under Constr.	Early 1957	UOP	Treco	Treco
Delhi-Taylor Oil.....	Corpus Christi	Udex Unit	4500 bbls.	.....	Under Constr.	Early 1957	UOP	Treco	Treco
Diamond Alkali.....	Houston	Perchlorethylene Exp.	50 percent	.....	Under Constr.	.....	.....	.....	.....
*Diamond Alkali.....	Houston	Acetylene Plt.	.....	.....	Engineering	.....	.....	.....	.....
*Dorchester Corp.....	White Deer, Tex.	Cat. Reformer	1,000 bbls.	$400,000	Under Constr.	June, 1957	Atlantic	Grebe & Doremus	Staff
Dow Chemical.....	Plaquemine, La.	Caustic Soda, Chlorine, Ethylene and Propylene Glycols and Oxides, Chlorinated Solvents	.....	Part of $20,000,000	Planning	.....	.....	.....	.....
Dow Chemical.....	Freeport, Texas	Acetylene, Methylacetylene, Ethanolamines, Synthetic Glycerine, Butadiene, Chlorine, Ethylene Oxide, Methyl Chloride, Glycerine, Glycol, Perchloro Ethylene and Styrene	.....	$45,000,000	Planned or Under Constr.	1958	.....	.....	.....
Du Pont.....	Orange	Exp. Polyethylene Fac.	.....	.....	Planning	.....	.....	.....	.....
Eastern States Petroleum Co.	Houston, Texas	Coking Plt.	13,000 bbls.	$4,000,000	Projected	.....	.....	.....	.....
El Paso Natural Gas.	Odessa, Texas	Butadiene	137 tons	$20,000,000	Designing	July, 1957	Houdry, Esso, Jasco	Fluor	Fluor
El Paso Natural Gas Products	El Paso, Texas	Alkylation Blending	.....	.....	Planning	.....	.....	.....	.....
Esso Standard.....	Baton Rouge	Ethylene, Butadiene Expan.; Wax, Lube Oil, Avgas	.....	$40,000,000	.....	.....	.....	.....	.....
Ethyl Corp.....	Baton Rouge	Vinyl-Chloride Monomer Pet.	.....	.....	Under Constr.	Late 1957	.....	Cat Constr.	Cat. Constr.
Firestone.....	Orange, Texas	Butadiene Plt.	40,000 tons/yr.	.....	Engineering	Spring, 1957	Houdry, Esso	Cat. Constr.	Cat. Constr.
Firestone Tire.....	Lake Charles, La.	Expand Synth. Rubber Plt.	†150,000 ton/yr.	.....	.....	.....	.....	.....	.....
General Petroleum....	Lake Charles, La.	Anhydrous Ammonia	100,000 tons/yr.	$12,500,000	Engineering	Fall 1957	.....	.....	.....
General Tire.....	Odessa, Texas	Copolymer Plt.	40,000 ton/yr.	$8,000,000	Under Constr.	March, 1957	.....	Fluor	Fluor
Goodyear Synthetic Rubber	Houston	Copolymer Expansion	200,000 tons/yr.	$9,000,000	Planning	Jan., 1957	.....	Blaw Knox	Tellepsen
Grace Chemical.....	Baton Rouge, La.	Polyethylene	50,000,000 lbs./yr.	$18,000,000	Under Constr.	Mid 1957	Phillips	Fluor	Fluor
Gulf Oil.....	Port Arthur, Texas	Two Gulfiners	45,000 bbls.	.....	Complete	.....	Gulf	Gulf, Kellogg	Kellogg
Gulf Oil.....	Pt. Arthur, Tex.	Inc. Ethylene Fac.	.....	.....	Considering	.....	.....	.....	.....
Gulf Oil.....	Port Arthur, Texas	Incl. Alkylation Cap.	3,200 bbls.	.....	Complete	.....	.....	Gulf; Kellogg	Kellogg
		Polymerization Inc.	2,800 bbls.	.....	Under Constr.	Summer, 1957	.....	Gulf; Procon	Procon
		Greasemaking; Packaging	.....	.....	Under Constr.	Late 1957	.....	Summer Sollitt	Summer Sollitt
		Sludge Decomposer	125 tons	.....	Engineering	Early 1957	Monsanto; Sonneborn	Leonard	Leonard
		Sulfur Recovery Inc.	60 tons	.....	Engineering	Early 1957	.....	Parsons	Parsons
Gulf Oil.....	Port Arthur	Platformer	26,000 bbls.	.....	Planning	Early 1958	UOP	Procon	Procon
J. M. Huber.....	Borger, Texas	Furnace Black	20-30,000,000 lbs./yr.	.....	Planning	.....	.....	.....	.....
Humble.....	Baytown	Inc. Butadiene Cap.	16,000 ton/yr.	.....	Under Constr.	Early 1957	.....	.....	.....
Humble.....	Baytown	FCC	55,000 bbls.	.....	Planning	.....	.....	Foster Wheeler	Foster Wheeler
*Humble.....	Baytown, Texas	Bensen Plt.	1,500 bbls.	.....	Under Constr.	Jan., 1958	.....	Parsons	Parsons
*Humble.....	Baytown, Texas	Ethylene Recovery Plt.	80,000,000 lbs./yr.	.....	Under Constr.	Mid, 1958	.....	.....	.....
Hyandotte Chemicals	Geismer, La.	Ethylene Oxide	.....	$8,000,000	Engineering	Late 1957	Shell	Lummus	Lummus
*Jefferson Chemical..	Port Neches, Texas	Inc. Ethylene, Double Ethylene, Glycol Cap., 50% Inc. of Ethylene Oxide Cap.	.....	.....	.....	.....	.....	.....	.....
*Jefferson Lake Sulphur	Houston	.....	.....	$3,500,000	.....	.....	.....	.....	.....
Kellogg.....	Houston	Polyolefines	.....	.....	Licensed	Phillips	.....	.....	.....
Lake Charles Chemical	Lake Charles, La.	Coking, Calcining Unit	10,000 bbls.	$6,250,000	Planning	Sept., 1957	.....	Fluor	Fluor
Magnolia.....	Beaumont, Tex.	TCC Unit	27,800 bbls.	.....	Under Constr.	Early 1957	Socony Mobil	Bechtel	Bechtel
		Sovaformer.....	20,000 bbls.	.....	Under Constr.	Early 1957	Socony Mobil	Bechtel	Bechtel
*Magnolia.....	Beaumont, Tex.	Crude Distil.	100,000 bbls.	.....	Engineering	Mid, 1958	.....	.....	Foster Wheeler
McBride Refining Co.	Port Brownsville, Texas	Ref. Expan.	†12,500 bbls.	$2,500,000	Planned	.....	.....	.....	.....
*Merichem.....	Houston	Plant Expan.	.....	$1,000,000	Under Constr. Engineering	Sept., 1957	.....	Tears	.....
MidSouth Chemical...	Lake Charles, La.	Ammonia Plt.	.....	.....	Planning	.....	.....	.....	.....
Monsanto.....	Luling, La.	Adipic-Acid	.....	.....	Under Constr.	Early 1957	.....	.....	.....
Northeast Texas Chemical Co.	East Texas	Chemical and Fertiliser Plt.	.....	.....	Planning	.....	.....	Tears	Beck
Pan-Am Southern Corp.	Destrehan, La.	Polyethylene, Polybutene	250 bbls.	.....	Complete	.....	Standard, Indiana	Tears	Tears
Panhandle Oil Corp...	Wichita Falls, Tex.	Platformer	3000	$625,000	Engineering	June, 1957	U.O.P.	Tears	Tears
Petroleum Chemicals..	Lake Charles	Anhydrone Ammonia	100,000 tons/yr.	$1,250,000	Under Constr.	Fall 1957	.....	Foster Wheeler	Foster Wheeler
Petroleum Chemicals..	Lake Charles, La.	Butadiene Plt., Expansion	†70,000 ton/yr.	$4,300,000	Complete	.....	.....	Fluor	Fluor
*Petroleum Chemical, Inc.	Lake Charles, La.	Ethylene Plt.	200,000,000 bbls./yr.	.....	Under Constr.	Jan., 1958	.....	.....	.....

Construction Box Score Continued on Page 243

Ready-made engineering staff for your custom-built plant...



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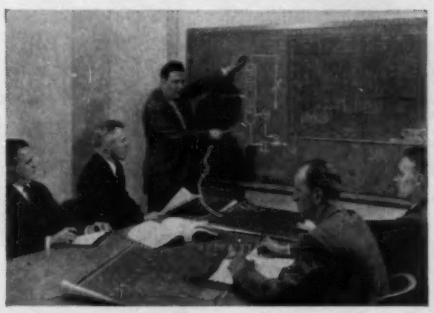

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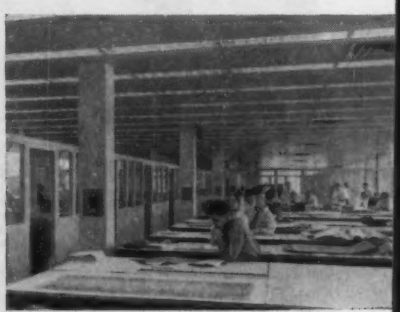

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REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Petro-Tex Chemical...	Houston	Butadiene Expansion	†45,000 tons/yr.	$1,000,000	Under Constr.	Early 1957	.....	Bechtel	Bechtel
Phillips Pet.....	Sweeny, Texas	Nat. Gas. Liquid Fractionation	30,000 bbls.	.....	Under Constr.	Early 1957	.....	S&W	S&W
		Inc. Alkylation	2,000 bbls.	.....	Under Constr.	March, 1957	.....	Phillips	Phillips
		Gas Cracking Facilities	8,200 bbls.	.....	Under Constr.	Spring, 1957	.....	S&W	S&W
Phillips Petroleum....	Sweeny, Texas	Pentane Fractionation	15,000 bbls.	.....	Planning	Fall 1957	UOP	Phillips	.....
*Phillips Petroleum...	Sweeny, Texas	Inc. Crude Capacity	10,000 bbls.	.....	Under Constr.	March, 1957	.....	Phillips	Phillips
		Inc. Cat. Reformer	2,000 bbls.	.....	Under Constr.	March, 1957	.....	Phillips	Phillips
		Inc. Cat. Crker.	.....	.....	Under Constr.	March, 1957	.....	Phillips	Phillips
*Phillips Petroleum...	Sweeny	Incl. Nat. Gas Liq.	20,000 bbls.	.....	Planning	Fall, 1957	.....	Phillips	.....
Phillips Petroleum....	Houston	Polyethylene Plt.	110,000,000 lbs./yr.	.....	.....	.....	.....	.....	.....
Phillips Chemical.....	Gulf Coast	Carbon Black	64,000,000 lbs./yr.	.....	Planning	.....	.....	.....	.....
Phillips Chemical.....	Sweeny, Texas	Ethylene	794,500 lbs.	$12,357,000	Under Constr.	April, 1957	.....	Phillips; S&W	S&W
Phillips Chemical.....	Pasadena, Texas	Polyethylene	301,000 lbs.	$31,525,000	Under Constr.	June, 1957	.....	Phillips	Farnsworth & Chambers
Phillips Chem. Co....	Phillips, Texas	Exp. Copolymer Plt.	138 tons	.....	Under Constr.	July, 1957	.....	Tellepsen; Phillips	Tellepsen
Phillips Chemical.....	Phillips, Texas	Exp. Butadiene Cap.	104 tons	.....	Under Constr.	July, 1957	.....	Tellepsen; Phillips	Phillips
Premier Oil Ref. Co...	Longview, Tex.	Cat. Poly. Plt.	.....	.....	Under Constr.	.....	.....	.....	.....
*Premier Oil Ref. Co..	Longview, Tex.	Platformer, Unifiner Revamp Crude Topping Thermal Cracking Units	4,500 bbls.	$1,250,000	Engineering Design	Early, 1957	UOP	Procon	Procon
*Premier Oil Ref. Co..	Longview, Tex.	Unifiner-Platformer	1,500 bbls.	.....	Under Constr.	April, 1957	.....	Procon	Procon
Rohm & Haas.....	Houston	Methanol	100 tons	.....	Engineering	1st Qtr., 1957	Texaco	Foster Wheeler	Foster Wheeler
Rohm & Haas.....	Houston	Acetylene	.....	.....	Planning	.....	.....	Chemico	Chemico
Shell Chemical.....	Norco, La.	Methyl, Ethyl, Ketone, Hydrogen Peroxide; Offsite Facl.	.....	.....	Under Constr.	March, 1957	.....	Braun, Fluor,	Braun, Fluor,
*Shell Chemical.....	Norco, La.	Exp. Isopropyl Alcohol Facl.	.....	.....	Under Constr.	1958	.....	.....	.....
*Shell Chemical.....	Houston	Exp. Isopropyl Alcohol Facl.	20,000,000 lbs./yr.	.....	Under Constr.	1958	.....	.....	.....
Sinclair Refg.....	Corpus Christi	Crude Recovery	.....	$550,000	Under Constr.	.....	.....	Tellepsen	Tellepsen
*Sinclair Refining.....	Houston	Hydrodesulphurization	24,000 bbls.	$5,600,000	Planning	.....	.....	.....	Parsons
Standard-Texas.....	El Paso	FCC	27,000 bbls.	$5,000,000	Planning	Sept., 1957	.....	Foster Wheeler	Foster Wheeler
Standard-Texas.....	El Paso	Ref. Exp.	†25,000 bbls.	.....	Under Constr.	4th Qtr. 1957	Esso	Staff, Fluor	Fluor
Suntide Refg.....	Corpus Christi	Unifiner	6000 bbls.	.....	Under Constr.	June, 1957	.....	UOP, Treco	Treco
		Rexformer	15,000 bbls.	.....	Under Constr.	June, 1957	UOP	UOP, Treco	Treco
		Udex Unit	7500 bbls.	.....	Under Constr.	Oct., 1957	.....	UOP, Treco	Treco
Texas City Refining...	Texas City, Tex.	Houdriformer	7,000 bbls.	$2,000,000	Under Constr.	Mid 1957	Houdry	Catalytic	Catalytic
Texas Butadiene & Chemical Corp.	Houston	Aviation Alkylate, Butylenes & Butadiene	.....	$26,000,000	Complete	.....	Houdry, Phillips	Houdry Fluor	Fluor
Texas Eastman.....	Longview, Texas	Inc. Oxo Fac.	.....	.....	Planning	.....	.....	.....	.....
Texas Eastman.....	Longview, Texas	Inc. Polyethylene Cap.	†20,000,000 lbs./yr.	.....	Planning	.....	.....	.....	.....
The Texas Co.....	Port Arthur	Stabilizer	.....	.....	Complete	.....	.....	Foster Wheeler	Foster Wheeler
		Power Plant	.....	.....	Under Constr.	Fall, 1957	.....	.....	Texaco
		Crude Unit	86,000 bbls.	.....	.....	.....	.....	.....	.....
		Cat Cracker	90,000 bbls.	.....	Engineering	Early, 1958	.....	.....	.....
		Inc. Alkylation	2000 bbls.	.....	.....	.....	.....	.....	.....
*The Texas Company.	Port Arthur, Texas	Vacuum Pipe Still	80,000 bbls.	.....	Under Constr.	Late, 1957	.....	Fluor	Fluor
Union Oil & Gas et al.	Eunice, La.	Gasoline Plt	300 Mmcf	.....	Under Constr.	July, 1957	.....	Fluor	Fluor
U. S. Rubber.....	Baton Rouge, La.	Petrochemicals	.....	$5,000,000	Under Constr.	July, 1957	.....	Walter Kidde	.....
*Wyandotte Chemical.	Baton Rouge, La.	Ethylene-Oxide Glycol	60,000,000 lbs./yr.	$8,000,000	Approved	Fall, 1957	Shell	Lummus	Lummus
*Wyandotte Chemical Co.	Baton Rouge	Electrolytic, Chlorine-Caustic Plt.	.....	$20,000,000	Engineering	Late 1958	.....	.....	.....
ROCKY MOUNTAIN									
American Gilsonite...	Gilsonite, Colo.	Gasoline from Gilsonite	7000 bbls.	$10,000,000	Under Constr.	May, 1957	.....	.....	Foster, Wheeler Kaiser Eng. Ferguson
		Hydrogen	550 Mmcf	.....	Engineering	.....	.....	Girdler	.....
Atlantic Refining Co.	Lovington, N.M.	Natural Gas	25 Mmcf.	.....	Projected	.....	.....	.....	.....
*Continental Oil Co...	Denver, Colo.	Cat. Reformer	3,500 bbls.	$1,400,000	Engineering	Nov., 1957	.....	Staff, Treco	Treco
El Paso Natural Gas Products	Gallup, N.M.	Refinery: Alkylation, Cat. Reforming, Cat. Cracking, Vacuum, Crude Unit	9,000 bbls.	$10,000,000	Under Constr.	Fall 1957	UOP	Sweco	Sweco
*Empire Petroleum...	Denver	Hydrodesulfurisation	1,000 bbls.	.....	Designing	Spring, 1957	British Petroleum	Litwin	.....
First National Petroleum Corp.	Jensen, Utah	Ref. Expan.	To 3,000 bbls.	.....	Planned	.....	.....	.....	.....
Malco Refineries	Roswell, N.M.	HF Alkylation	900 bbls.	.....	Under Constr.	Mar., 1957	UOP	UOP	Grebe & Doermus
*Phillips Petroleum...	Great Falls, Mont.	Cat. Cracking	3,000 bbls.	.....	Under Constr.	Spring, 1957	.....	Procon	Procon
Salt Lake Refg.....	Salt Lake City	Inc. Cap.	5000 bbls.	.....	Planning	.....	.....	.....	.....
		Reformer	6000 bbls.	.....	Planning	Sept., 1957	.....	.....	.....
Sioux Oil Co.....	Newcastle, Wyo.	LPG Unit	.....	$75,000	Complete	.....	.....	Litwin	Litwin
*Socony Mobil.....	Casper, Wyo.	Cat. Reforming	3,000 bbls.	.....	Pre-engineering	Late, 1957	.....	Pritchard	Pritchard
		Cat. Hydrodesulfurisation	3,250 bbls.	.....	Pre-engineering	Late, 1957	.....	Pritchard	Pritchard
Standard-Indiana.....	Casper, Wyo.	Lube Oil Plt.	5,000 bbls.						
		Vacuum Pipe Still	4,800 bbls.						
		Propane Deasphalting	1,000 bbls.	.....	Under Constr.	May, 1957	.....	Foster Wheeler	Foster Wheeler
		Furfural Extraction	1,500 bbls.						
		MEK Dewaxing Deoiling	2,000 bbls.						

Construction Box Score Continued on Page 247

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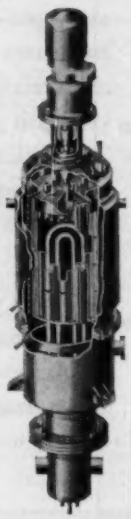
Lemons, fatty acids, and tall oil—from new wiped-film evaporator

More and more industrial firms are uncovering areas of greater profit with Pfaudler's new wiped-film evaporator — introduced *only four months ago*. This improved evaporator offers low-cost development opportunities to many industries employing vacuum distillation, e. c., chemical process, food, petroleum, pharmaceutical, and plastics.



CUTAWAY VIEW of the 12-inch Pilot Plant Evaporator. Product capacities of this model range from 40 to 1000 pounds per hour. The quality of results you obtain from Pfaudler's small units can be dependably duplicated in production size units.

One chemical company is experimenting with extra-fast recovery of naphthenic acid and *tall* oil. A food processor is obtaining a more concentrated lemon distillate in less time than ever before. Promising results have been obtained for other companies involving Ethylene Glycol, corn oil, soybean oil and various fatty acids.

Higher heat transfer rates and faster evaporation contribute to greater profits and purer distillates in many other areas. If product purity, speed, and profit are uppermost in *your* area, you should compare Pfaudler's new, improved wiped-film evaporator with your present distillation equipment. It offers you these important benefits:

Improved Heat Transfer—high heat transfer rates are possible for even highly viscous products, due to the turbulence-promoting carbon blades.

Short Contact Time—as low as a fraction of a second; thus, no thermal deterioration of heat sensitive materials.

Uniform Film Thickness—walls cleanly wiped so as to promote controlled turbulence and uniform thin film thickness without fouling and solids build-up.

Low Operating Pressure—from atmospheric to a fraction of a millimeter.

Minimum Pressure Drop—pressure drop between evaporator and condenser held to less than 1/10 millimeter of mercury at one mm Hg operating pressure.

Economical Operation—due to high heat transfer, short contact time, and low power consumption; thus, operations are more efficient and less costly.

Space Saving—an internal rather than an external condenser is built into the still, thus eliminating interconnecting piping and the waste of costly floor space.

Low Maintenance—foot bearing not required, slow operating speed minimizes wear, and "floating" wiper blade is unaffected by thermal expansion.

Three standard models are available: the two-inch laboratory evaporator; the 12-inch pilot plant evaporator and the 36-inch production model. More complete facts about any one of these units can be found in Data Sheet No. 39.

Mail the coupon today. Or ask your Pfaudler representative for details.

PRETEST YOUR PRODUCT FREE in this Pfaudler pilot plant glassed steel dryer-blender. This standing offer has enabled many chemical manufacturers to predict performance on new materials or compare operation with conventional equipment. Complete reports are furnished or you can send your own man to observe results. To date, Pfaudler units have reduced drying and blending cycles drastically over previous methods. For an appointment, call your nearest Pfaudler office or use coupon, if preferred.

Exclusive dimpled jacket cuts stainless steel costs

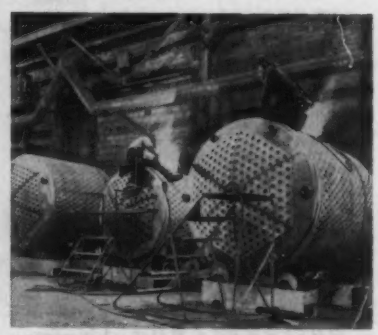
Costs can be reduced greatly with Pfaudler's code-approved dimpled jacket design—for several reasons:

The design enables a stainless steel vessel to withstand much greater jacket pressures than it ordinarily could. In fact, jacket pressures up to 150 psi *require no increase in metal thickness!* Such savings in material represent sizable savings in cost.

Costs are further reduced through standardization. Dimpled jacketed reactors—kettles are available in standard 750- to 2000-gallon sizes. Constructed of Types 304 and 316 stainless steel, many sizes are carried in stock along with such prefabricated parts as nozzle openings, agitators, stuffing boxes, and drives.

Generally, units from 5 to 500 gallons come equipped with conventional jackets and clamped-top heads. Openings are ample and will meet most process requirements.

Standardization assures quick delivery—so the costs of preparing engineering drawings and estimating prices are reduced.



CODE-ACCEPTED for pressures far beyond conventional jackets of equivalent wall thickness, Pfaudler dimpled jacketed reactors point the way to reduced costs.

Corrosioneering News

Quick facts about services and equipment available to help you reduce corrosion and processing costs.

You can actually cut stainless steel costs in more ways than one by specifying Pfaudler's dimpled jacketed design. Contact your Pfaudler representative for more information.

Or mail the coupon today. Ask for Bulletin 904.

No need to spend or wait for special polymerizers

Engineering experience with all types of polymerizers has led Pfaudler to incorporate their best features into *standard* designs. You can cut costs and get faster delivery by specifying one of these standard glassed steel polymerizers.

Pfaudler glassed steel polymerizers for the production of polyvinyl chloride.

Available in 2000- or 3700-gallon sizes, Pfaudler's reactors are rated for either 150 or 200 psi. They are engineered to give you adaptability to a wide range of services.

Standard Pfaudler polymerizers offer these important benefits:

Reduced cost—glassed steel costs less than alloy materials. Savings are especially high when high-pressure construction is required.

Assured purity—all surfaces in contact with the product are nonmetallic. Glass *cannot* discolor products or act as a catalyst to promote unwanted side reactions.

Easy to clean—practically nothing adheres to a glass surface. Cleaning is simple and fast.

Easy to operate—a larger manhole and demountable blade agitator result in more convenient operation.

Before you spend and wait for a special design, check the adaptability of Pfaudler's *standard* glassed steel polymerizers. Mail the coupon for more information—ask for Bulletin 932.

Emergency at Gamma Chemical met by 3-day delivery of 500-gallon reactor

When extra processing capacity was urgently needed recently at Gamma's Great Meadows plant in New Jersey to custom process a new organic chemical, Gamma called Pfaudler and asked how fast a 500-gallon reactor could be shipped.

"How about the day after tomorrow," countered Pfaudler. "Sold!" said Gamma. Waiving the normal ten-day delivery schedule, Pfaudler rushed a standard unit through the shop even before the customer's written order arrived. The emergency was met—a 500-gallon glassed steel reactor was shipped—in just *three days' time!*

Gamma Chemical's plight points up one of the ways you can benefit from Pfaudler's policy of stocking standard glassed steel reactors. Fast delivery provides only one of the savings, however. You can also cut initial costs by eliminating special engineering drawings, special parts and material custom-designed units require.

You get an adaptable, corrosion-resistant reactor whenever you specify a standard Pfaudler glassed steel vessel—resistant to all acids (except HF) and alkaline solutions up to pH12. Each reactor is completely assembled and ready to ship within two weeks from receipt of your order.

Take advantage of Gamma Chemical's experience and check with Pfaudler before you buy your next reactor. Contact your Pfaudler representative for more information on standard reactors. Units stocked for ten-day delivery include the following capacities: 30, 50, 100, 200, 300, 500, 750, 1000 and 2000 gallons. Check the coupon for sizes in which you are interested.

READY TO GO. A standard 500-gallon reactor is readied for quick shipment to Gamma Chemical. This vessel was on its way to Gamma's Great Meadows plant even before a written order had arrived!

THE PFAUDLER CO., Dept. PR-1, Rochester 3, N.Y.

Please send me ☐ Wiped-Film Evaporator Data Sheet 39 ☐ Bulletin 932—Glassed Steel Polymerizers ☐ Dryer-Blender Data Sheet 26 ☐ Standard Glassed Steel Reactors, Bulletin 860 ☐ Stainless Steel Equipment, Bulletin 904 ☐ Standard Heat Exchangers, Bulletin 519.

Name.....

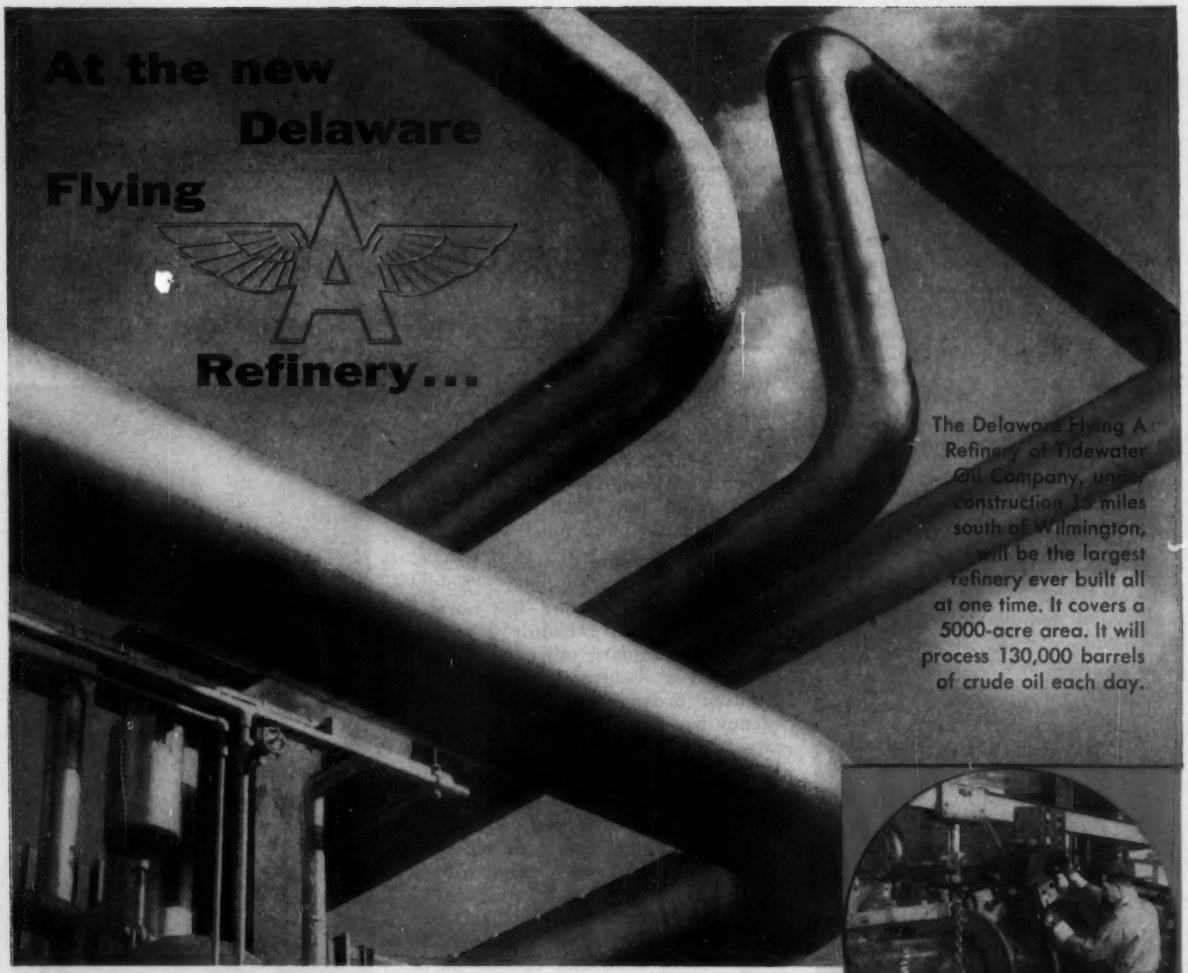
Title.....

Company.....

Address.....

City..... Zone..... State.....

For more data on advertised products, use Readers' Service Cards, last page.



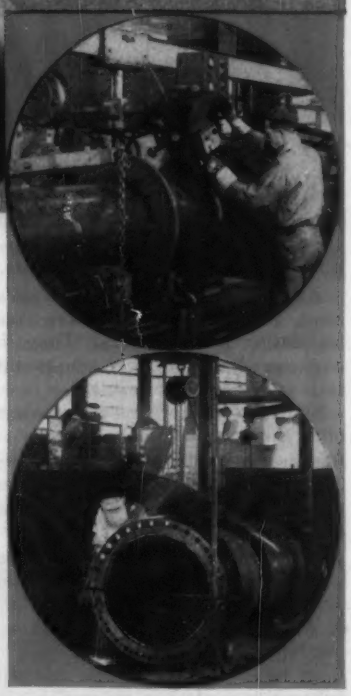
The Delaware Flying A Refinery of Tidewater Oil Company, under construction 13 miles south of Wilmington, will be the largest refinery ever built all at one time. It covers a 5000-acre area. It will process 130,000 barrels of crude oil each day.

SHOP-FABRICATED PIPING BY GRINNELL

With Grinnell shop-fabricated piping — cutting, fitting, welding and assembly "on location" is reduced to an absolute minimum. This fact should be of major importance to everyone installing piping. For when these operations are performed under the less-than-ideal conditions existing in the field, there is always the possibility of less-than-perfect results. Errors in cutting or fitting can occur — or welds can contain slight imperfections, which may be difficult to detect with field equipment.

In Grinnell shops, on the other hand, whole sections of complex piping are assembled — every critical point checked with the latest equipment and by the most modern methods. When these sections arrive on site, they go up fast and right.

With Grinnell shop-fabrication, too, there are no unforeseen costs. Included in the price (which is determined in advance) are such items of expense as: interpretive engineering, shop sketches and planning; procurement of materials, power services, expendable tools and supplies. There are no charges for waste material or spoilage. Consult Grinnell on your next piping installation.



Welding under ideal conditions in Grinnell shop. (Top) Automatic, submerged-arc welding machine. (Bottom) One of many Grinnell welders who must meet full operator qualifications of the ASME and ASA codes.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

For more data on advertised products, use Readers' Service Cards, last page.

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licenser	Engineering	Contractor
Texas Natural Gasoline	Baker, Mont.	Gasoline Plt	.....	.....	Complete	.....	.....	.....	.....
Union Oil Co. (Calif.).	Grand Valley Colo.	Shale Demonstration Plt.	300 tons/day	$3,200,000	Complete	.....	.....	Stearns-Rogers	Stearns-Rogers
WEST COAST									
Brea-Koppers.....	Los Angeles	Polyethylene	60,000,000 lbs./yr.	.....	Planning	Mid, 1958	Koppers	Koppers	Koppers
Bordes.....	Kent, Wash.	Formaldehyde	36,000,000 lbs./yr.	.....	Under Constr.	Late 1956	.....	.....	.....
*Douglas Oil Co.....	Los Angeles	Unifiner	.....	.....	Under Constr.	June, 1957	.....	.....	Macco
		Topping Plt.	12,000 bbls.		Planned	.....	.....	.....	.....
Dow Chemical.....	Pittsburg, Calif.	Synthetic Latex	.....	$1,000,000	Under Constr.	.....	.....	.....	.....
Du Pont.....	Antioch, Calif.	Fluorinated Hydrocarbons. Tetrethyl Lead	.....	.....	Under Constr.	.....	.....	.....	.....
*Ethyl Corp.....	San Francisco	Petrochemical Plt.	.....	.....	.....	.....	.....	.....	.....
General Petroleum....	Ferndale, Wash.	Sovaformer	9,000 bbls.	$6,300,000	Engineering	Sept., 1957	Socony	Socony, Bechtel	Bechtel
		Stove Oil Treater			Complete	.....	Socony	Socony	Petroco
		Jet Fuel Treater			Complete	.....	.....	Socony	Petroco
General Petroleum...	Torrance, Calif.	Exp. Gasoline Plt.	.....	.....	Under Constr.	.....	.....	.....	.....
*General Petroleum...	Torrance, Calif..	Sozaformer	12,000	$8,000,000	Engineering	Late, 1957	Socony	Socony, Bechtel	Parsons
Golden Bear Oil Co...	Bakersfield, Calif.	Inc. Crude Cap.	4,000 bbls.	$125,000	Under Constr.	1957	.....	.....	Staff
Hancock Chemical....	Wilmington, Calif.	Inc. Sulfur Recovery	†130 tons	$1,500,000	Complete	.....	.....	Parsons	Parsons
Phillips Pacific.....	Kennewick, Wash.	Ammonia Plt.	200 tons	$12,000,000	Under Constr.	Feb., 1957	.....	Fish-Phillips	Fish
Shell Chemical.....	Torrance, Calif.	Exp. Butadiene Plt.	.....	.....	Under Constr.	Early 1957	.....	.....	.....
		Mod. Copolymer Plt.	.....	.....	.....	.....	.....	.....	.....
*Shell Chemical.....	Dominques, Calif.	Exp. Isopropyl Alcohol Facl.	.....	.....	Under Constr.	1958	.....	.....	.....
*Shell Oil.....	Dominques	Platformer	.....	.....	.....	.....	.....	Kaiser	Kaiser
Standard Oil (Calif.	Richmond	Refinery	20-30,000 bbls.	$25-30,000,000	Planned	Late 1957	.....	.....	.....
*Standard Oil (Calif.).	Everett, Wash.	Refinery	60,000 bbls.	$75,000,000	Planning	Jan., 1959	.....	.....	.....
*Standard Oil (Calif.).	Los Angeles	Unifiner	.....	.....	Under Constr.	June, 1957	.....	.....	Macco
Stauffer Chemical....	Dominquens, Calif.	Sulfuric-Acid Plt.	.....	$2,000,000	Under Constr.	Early 1957	.....	.....	.....
Stauffer Chemical...	Compton, Calif.	Sulfuric Acid	.....	$57,070	Engineering	.....	.....	.....	.....
Stauffer Chemical...	Richmond, Calif.	Sulfuric Acid	.....	$283,500	.....	.....	.....	.....	.....
Straits Refining.....	Puget Sound	Refinery	8,000 bbls.	$26,430,000	ODM Approved	.....	.....	Tears	Tears
The Texas Co.....	Anacortes, Wash.	Refinery	.....	.....	Planning	.....	.....	.....	.....
Tidewater.....	Avon, Calif.	Fluid Coker	42,000 bbls.	.....			.....	Bechtel	Bechtel
		Hydrodesulfuriser	24,000 bbls.	.....			.....	Bechtel	Bechtel
		Gas Plt.	.....	.....	Under Constr.	Early 1957	.....	Bechtel	Bechtel
		Exp. Fluid Cat. Cracking	.....	.....			.....	Bechtel	Bechtel
*Union Oil.....	Los Angeles	Ethylene Plt.	100 million lbs./yr.	.....	Under Constr.	4th Qtr., 1957	Fluor	.....	Fluor
U. S. Oil & Refining	Tacoma, Wash.	Refinery	15,000 bbls.	.....	Under Constr.	1957	UOP	J. B. Gill	J. B. Gill
*U.S. Oil & Refining..	Tacoma	Cat. Reformer	2,700 bbls.	.....	.....	.....	.....	Holmes & Narver	Holmes & Narver
Wilshire Oil.....	Norwalk, Calif.	Unifiner-Platformer	10,000 bbls.	.....	Under Constr.	Jan., 1957	UOP	Sweco	Sweco
OUTSIDE U.S.A									
Canada									
Anglo-Canadian.....	Sarnia, Ont.	Ref. Exp.	25,000 bbls	.....	Complete	.....	.....	.....	.....
			30,000 bbls.	.....	Under Constr.	1957	.....	.....	.....
British American Oil..	Clarkson, Ont.	Cat. Reforming	10,250 bbls.	$4,000,000	Under Constr.	Early 1957	Atlantic	Lummus	Lummus
British American.....	Clarkson, Ont.	Desulfurisation	12,000	.....	Under Constr.	Early, 1957	.....	Lummus	Lummus
		Crude Exp.	40,000	$5,500,000	Under Constr.	Early, 1958	Atlantic	Kellogg	Kellogg
British American.....	Montreal	Desulfurisation	15,550	.....	Engineering	Early, 1957	.....	Lummus	Lummus
		CO Boiler	.....	$650,000	Under Constr.	Early, 1957	Babcock-Wilcox	Babcock-Wilcox	Babcock-Wilcox
British American.....	Nevis, Alba.	Gasoline Plt.	20 Mmcf	.....	Complete	.....	.....	.....	.....
British American.....	Nevis, Atla.	Sulfur Recovery	225 tons	.....	Under Constr.	1957	.....	Parsons	Parsons
Canadian Hydrocarbons, Ltd.	Winnipeg, Manitoba	Fertilizer Plt.	600 tons	$18,500,000	Planning	.....	.....	.....	.....
Canadian Industries	Millhaven, Ont.	Anhydrous Ammonia Plt.	200 ton	$8,000,000	Complete	.....	Texaco	Girdler (Canada) & CIL	Girdler (Canada)
Canadian Oil.....	Sarnia	Udex Unit-Reformer	3,650 bbls. 4,400 bbls.	$3,000,000	Planning	Aug., 1957	UOP	UOP, Staff	Fluor
Canadian Petrofina...	Montreal	Increase Cap.	.....	.....	Planning	.....	.....	.....	.....
Canada Southern Oils	Saskatchewan	Refinery	10-20,000 bbls.	$7,000,000-$10,000,000	.....	.....	.....	.....	.....
*Cities Service.....	Toronto	New Refinery	20,000 bbls.	$22,000,000	Engineering	.....	.....	Braun, Ltd.	Braun, Ltd.
Consumers Coop.....	Regina	Refinery Expan.	†3,500 bbls.	$2,000,000	Complete	.....	.....	.....	.....
Dow Chemical.....	Sarnia, Ont.	Ethanolamine	.....	$1,000,000	Complete	.....	.....	Catalytic	Catalytic
Du Pont.....	Maitland, Ont.	Orlon Plt.	.....	.....	Planning	.....	.....	.....	.....
Ethyl Corporation of Canada, Ltd.	Sarnia, Ont.	Anti-Knock Compound Plt.	.....	$14,000,000	Complete	.....	.....	.....	.....
Goodrich, Canada....	Niagara Falls	Polyvinyl Geon	.....	$3,500,000	Planning	Early 1957	.....	McKee	McKee
Imperial Oil.....	Halifax	Powerformer	7,000 bbls.	$4,300,000	Under Constr.	March, 1957	Esso	Foster Wheeler	Foster Wheeler
Imperial Oil.....	Sarnia	Detergent Alkylate	.....	$4,000,000	Under Constr.	Mid 1957	.....	.....	.....
Imperial Oil.....	Redwater, Ala.	Gas Processing Plt.	10 Mmcf	$3,000,000	Complete	.....	Brown & Root	.....	.....
Imperial Oil.....	Sarnia	Expan. of Wax Facl.	35,000,000 lbs./yr.	$4,500,000	Complete	.....	.....	Fluor, Imperial	Fluor
Imperial Oil.....	Sarnia, Ont.	Cat. Reformer	13,500 bbls.	$7,200,000	Complete	.....	.....	Fluor; Imperial	Fluor
Imperial Oil.....	Halifax	FCC	15,000 bbls.						
		Cat. Poly	5,000 bbls.	.....	Complete	.....	.....	.....	Foster Wheeler
		Powerformer	7,000 bbls.						
Imperial Oil.....	Montreal	Cat. Reformer	9,000 bbls.	$5,100,000	Under Constr.	Early 1957	.....	Fluor	Fluor
Imperial Oil.....	Ioco, B.C.	Powerformer Prefractionator Hydrofiner	5,000 bbls.	$4,000,000	Engineering	3rd Qtr., 1957	Esso	.....	.....
Imperial Oil.....	Sarnia	Petrochemical Plt.	.....	$25,000,000	Engineering	Spring, 1958	.....	Canadian Bechtel	Canadian Bechtel
*Imperial Oil.....	Winnipeg	Add Crude Cap.	.....	.....	.....	.....	.....	.....	.....
		Powerformer	.....	.....	Planning	.....	.....	.....	.....

Construction Box Score Continued on Page 249

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

INSIDE STORY
on cooling tower pH

Deep in the interior of a giant cooling tower visibility is obscured by shadows, and haze that's actually cooling water, falling like rain down into the tower basin, where it's collected and recirculated to the condensers.

Keeping this water at optimum pH, when it collects in the basin, was once a difficult problem. But the application of practical engineering principles, resulting in the baffle-lined distributing trough and regulated reagent feed shown here, plus L&N's pH Controllability Analysis, offers a new and successful solution to this problem.

For it's here, *inside the tower*, that vital pH control can be most effective for slime control, scale prevention, wood protection, and conservation of make-up water.

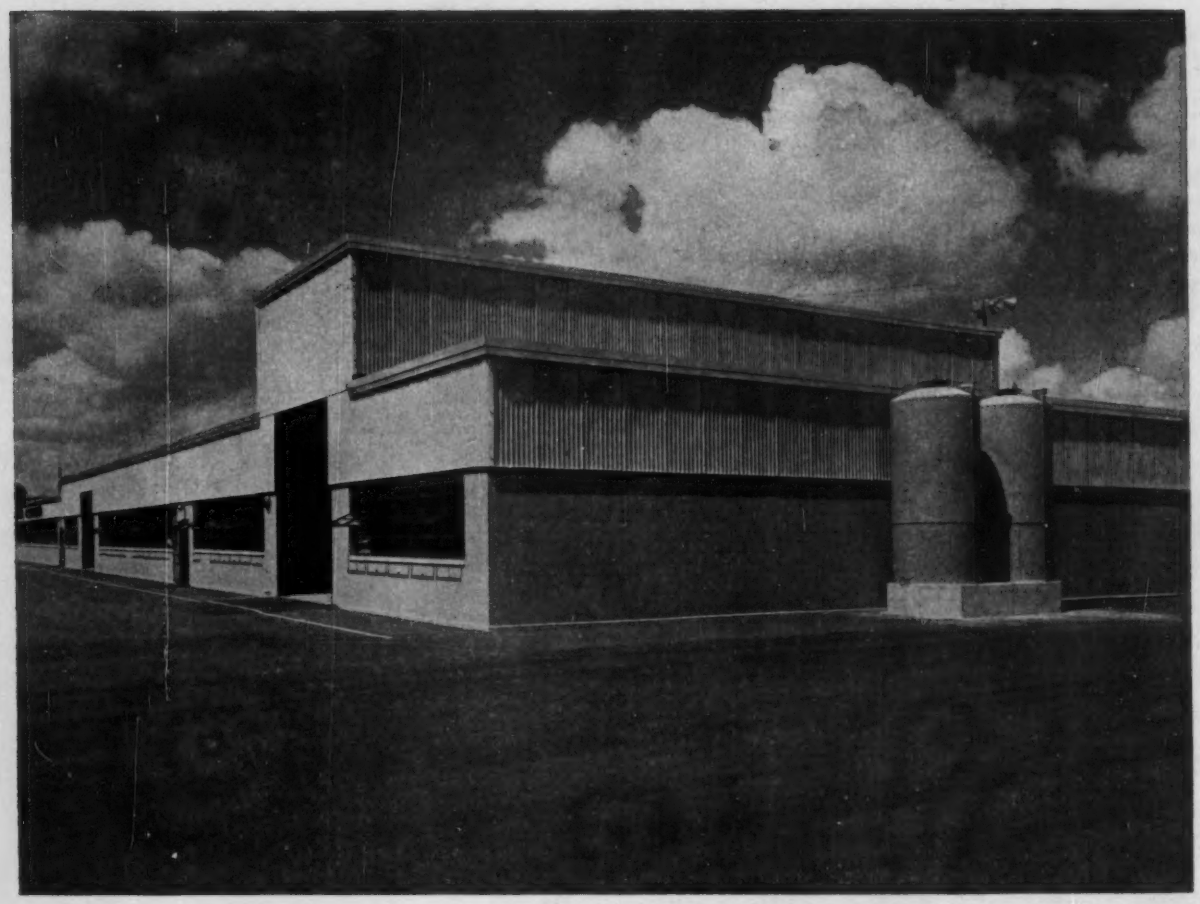
We'll be glad to send you details on the "inside story" of tower pH. Write Leeds & Northrup Co., 4907 Stenton Ave., Phila. 44, Pa., for Process Data Sheet 700(1).

LEEDS [N] NORTHRUP
instruments — *automatic controls • furnaces*

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
McColl-Frontenac	Edmonton, Alta.	Platformer	3,300 bbls.	$900,000	Engineering	1957	UOP	Treco	Treco
*McColl Frontenac	Montreal East	Hydratreater	10,000 bbls.	$1,000,000	Engineering	Late, 1957	Texas Co.	Foster Wheeler	Foster Wheeler, Ltd.
Midland Pet. & Pacific Pet.	Stettler, Alta.	Crude Refinery	4,000 bbls.	$2,000,000	Under Constr.	.....	.....	.....	.....
Northwest-Nitro Chemical	Medicine Hat, Alta.	Phosphoric-Acid Plt.	.....	.....	Under Constr.	.....	.....	Fluor	Fluor
Northwest Nitro-Chemicals, Ltd.	Medicine Hat, Alberta	Nitrogen Plt.	.....	$23,000,000	Complete	.....	.....	Commercial Solvents	Ford, Bacon & Davis, Kellogg
Pacific Petroleum	Fort St. John, B.C.	Gas-Absorption Plt.	.....	$18,000,000	Planning	.....	.....	.....	.....
*Pacific Petroleum & Phillips Petroleum	Taylor, B.C.	Refinery Expan.	.....	.....	.....	.....	.....	.....	.....
Polymer Corp., Ltd.	Sarnia, Ont.	Ethylene Plt. Expan.	.....	$2,000,000	Under Constr.	Early 1957	.....	Staff	Staff
Polymer Corp., Ltd.	Sarnia, Ont.	Plt. Expansion	.....	.....	Engineering	.....	.....	Catalytic	Canadian General Electric
Quebec Ammonia	Montreal	Ammonia Nitric Acid—80 tons Nitrogen Solutions	120 tons	$8,000,000	Planning	.....	Texaco	Girdler	Girdler
Regent Refining	Port Credit, Ont.	Fluid Cat Crker., Vacuum Distillation, Gas Polymerization	....	$5,500,000	Planning	1957	.....	Procon	Procon
Shawinigan Chemicals	Shawinigan Falls, Quebec	Sulfuric Acid	75 tons	$750,000	Complete	.....	.....	Chemico	Chemico
Shawinigan	Montreal	Exp. Phenol Plt.	.....	.....	Under Constr.	Early 1957	.....	Staff	Staff
Shell Oil (Canada)	Alberta	Refinery	.....	.....	Studying	.....	.....	.....	.....
Shell (Canada)	Bronte, Ont.	Refinery	.....	.....	Considering	.....	.....	.....	.....
Sherritt-Gordon Mines, Ltd.	Fort Saskatchewan, Alta.	Anhydrous Ammonia	75 tons	$24,000,000	Planned	.....	.....	.....	.....
Surpass Petro-Chemicals	Scarborough, Ont.	Sulphonates	20,000 lbs.	$350,000	Complete	.....	Bray	Girdler	Staff
LATIN AMERICA									
Argentina									
Fabrica Argentina	San Nicholas	Phenol Plt.	.....	$375,000	Complete	.....	.....	.....	.....
Brazil									
Alba (Borden)	Cubatao	Methanol, Formaldehyde, Synthetic Resins	30 tons	$3,500,000	Engineering	Late 1957	Vulcan	Vulcan	Staff
Cia Brasiliera de Estireno	Cubatao	Styrene Monomer Plt.	.....	.....	Complete	.....	Koppers, Firestone	Koppers	Koppers
Copebras	Cubatao	Carbon-Black	18,000 tons/yr.	.....	Engineering	.....	.....	.....	.....
Petrobras	North Brazil	Refinery	25,000 bbls.	.....	Studying	.....	.....	.....	...
Petrobras	South Brazil	Refinery	70,000 bbls.	.....	Studying	.....	.....	.....	...
* Petrobras	Cubatao	Ethylene Recovery Unit	40,000,000 lb./yr.	.....	Under Constr.	Mid, 1957	.....	Hydrocarbon, Edeleanu	.....
*Petrobras	Mataripe	Atmospheric & Vacuum Distil. Units, Cat. Crker, Gas Recovery, Wax Treating	37,000 bbls.	.....	Engineering	Mid, 1959	Kellogg	Kellogg	Kellogg
*Petrobras	Rio de Janeiro	New Refinery	90,000 bbls.	.....	Studying	1960	.....	.....	.....
Ubde	Cubatao	Urea Pet.	.....	.....	.....	.....	.....	Ubde	Ubde
Union Carbide	Cubatao	Styrene Monomer	.....	.....	Engineering	.....	.....	.....	.....
Colombia									
Colombian Petroleum Company	Barco Concession	Gas Treating Plt.	2,000 bbls.	$5,000,000	Under Constr.	.....	.....	.....	.....
*Empresso Colombiana de	El Centro	Plt. Modernisation	2,000 bbls.	$3,000,0000	Planning	.....	.....	.....	.....
Empresa Nacional Petroleos	Barranca Bermeja	Exp. Propane Recovery Petrochemicals	2,000 bbls.	$3,000,000	Planning	.....	.....	.....	.....
International Petroleum (Colombia), Ltd.	Cartagena	Refinery	26,500 bbls.	$32,500,000	Planning Under Constr.	..... 3rd Qtr., 1957	..... Esso	..... Bechtel	..... Bechtel
Cuba									
Esso Standard	Havana	Ref. Expan.: Distillation, Polymerisation, Powerforming, Hydroforming, Cat. Cracking	To 35,000 bbls.	$30,000,000	Under Constr.	Late 1957	Esso	McKee	McKee
Refinadora Cabaiguan	Cabaiguan, Cuba	Ref. Expan.	.....	.....	Planning	.....	.....	.....	.....
Shell de Cuba	Havana	Distillation, Cat. Reforming	25,000 bbls.	.....	Complete	.....	.....	Bechtel	Bechtel
The Texas Co.	Santiago	Refinery	20,000 bbls.	$14,000,000	Under Constr.	Early, 1957	.....	.....	.....
Mexico									
Pemex	Mexico City	Cat. Cracking Gas Concentration, HF Alkylation; Polymerization; Ethylene; Sulfure	16,000 bbls.	$12,500,000	Under Constr.	Late 1957	Esso-Phillips U.O.P.	McKee	Staff
Pemex	Pemex City	Nat. Gaso. Plt.	300 Mmcf	$7,400,000	Under Constr.	Mid. 1957	.....	Hudson	Staff
Pemex	Ciudad Madero	Topping Cat. Cracking Gas Concentration; HF Alkylation; Polymerization; Sulfure Plt.	100,000 bbls. 16,000 bbls.	$25,700,000	Under Constr.	Mid 1958	Phillips, Esso UOP	McKee	Staff
Pemex	Minatitlan	Vacuum Distillation; Clay Treating; Lube Oil	1,000 bbls.	$2,500,000	Under Constr.	Mid 1957	.....	Fluor	Staff
Pemex	Salamanca	Grease Plt.	25 tons	$1,700,000	Engineering	Early, 1957	.....	McKee	Staff
Pemex	Poza Rica	Cat. Cracker Topping Plt.	15,000 bbls. 10,000 bbls.	..... $1,350,000	Planning Engineering	..... Mid 1957	....	..... Staff	..... Staff
Netherlands Antilles									
Lago O&T	Aruba	Improve Distillates Upgrading Fac.	20,000 bbls.	$4,200,000	Complete	.....	.....	Badger Mfg.	Badger Mfg

Construction Box Score Continued on Page 251



K&M Corrugated Asbestos Sheets, used as siding on the Operations Center of a southeastern utility company, complement the clean, modern lines of the building. These sheets are also used on a pitched roof, not shown in the photograph. Engineering and supervision of construction: Stone and Webster Engineering Corporation. Applicator: Whatley Roofing and Sheet Metal Works, Tampa, Florida.

Attractive, weather-proof, fire-proof, maintenance-free
K&M Corrugated Asbestos

Building a new plant? Modernizing your present one? In either case, you'll gain important cost and other advantages with K&M Corrugated Asbestos-Cement Sheets. They cannot burn, can't rot or corrode—withstand the ravages of time and weather year after year. Because K&M Corrugated Asbestos-Cement Sheets rarely require maintenance, *never* need protective painting, their upkeep is held to the barest minimum.

Easy to apply. These corrugated sheets offer big savings in application costs. They go on quickly, are easily sawed, drilled, and fitted on the job.

Write for complete details on K&M Corrugated Asbestos Roofing and Siding.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

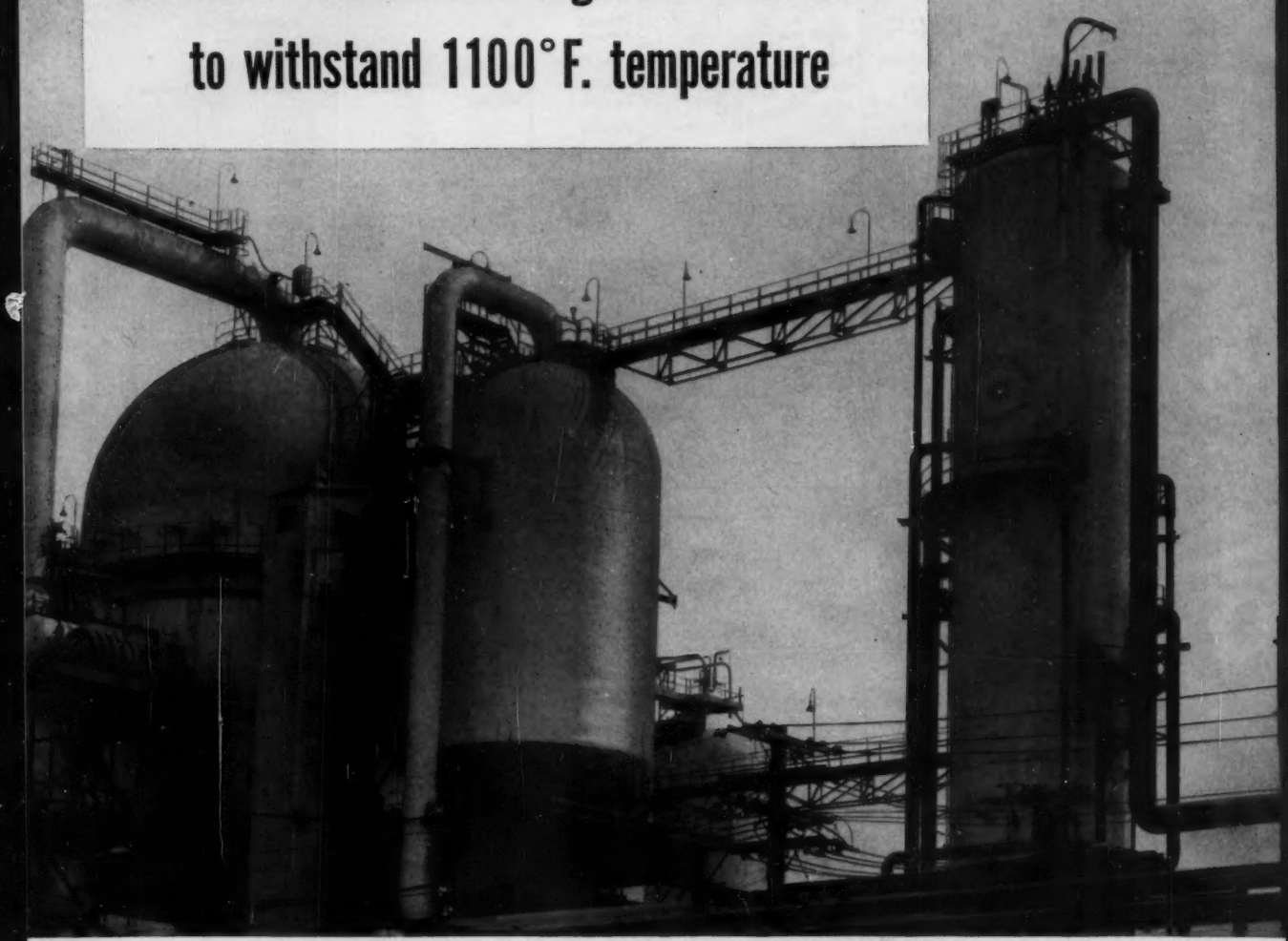
K&M best in asbestos®

REFINER AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
N. V. Curacaosche Petro. Ind. Mij.	Curacao	Feed Prep.	20,000 bbls. 33,000 bbls.	.....	..... Planned	Mid 1957 End, 1957	.....	S & W. Badger Div., E. B. Badger, Ltd.	....
N.V. Curacaische Petro. Ind. Mij	Curacao	Cat Cracker	33,000 bbls.	.....	Under Constr.	Late 1957	.....	N.V. De Batanfache Pet. Mij	Werkspoor, N.V.
Panama									
Refineria Petroquimica de Panama	Colon	Refinery	55,000 bbls.	.....	Planning	.....	.....	.....	.....
Refineria Panama	Colon	Refinery	70,000 bbls.	.....	Planning	.....	.....	.....	.....
Peru									
Fertiza Limitada.....	Peru	Fertiliser Plt.	.....	.....	Planning	1957	.....	Montecatini	.....
Helios, S.A.	San Andres	Fertiliser Plt.	130,000 tons	.....	Planning	.....	.....	.....	.....
Puerto Rico									
Commonwealth Oil Refining Co.	Guayanilla Bay	Houdryformer	26,800 bbls.	.....	Under Constr.	.....	Houdry	.....	.....
Gonsales Chemical .	Guanica	Ammonia	125 tons	$12,250,000	Complete	.....	Texaco	Lummus	Lummus
Union Carbide Caribe	Ponce	Ethylene-Glycol	.....	$2,800,000	Planning	Mid 1958	.....	.....	.....
Venezuela									
Mene Grande-Creole.	San Joaquin	Gasoline Plt.	.....	$2,300,000	Planning	.....	.....	.....	.....
Cia Shell de Venesuela	Cardon	Cat. Crker.	33,000 bbls.	.....	Under Constr.	1st Qtr., 1957	.....	.....	.....
Cia Shell de Venesuela	Cardon	Polymerisation; Treater, Feed Preparation	.....	.....	Under Constr.	.....	.....	H.W.P.	.....
Cia Shell de Venesuela.	Cardon	Feed Prep.	66,000 bbls.	.....	Complete	.....	.....	S & W Badger Div., E. B. Badger, Ltd.	.....
Shell (Venesuela)	Cardon	Distillation	80,000 bbls.	$20,000,000	Planning	Mid 1958	.....	.....	.....
		Alkylation	2300 bbls.	.....	Under Constr.	1st Qtr., 1957	.....	.....	.....
*Companhia Shell de..	Cardon	Cat. Crker.	33,000 bbls.	.....	Under Constr.	2nd Qtr., 1957	.....	.....	.....
		Alkylation Plt.	2,300 bbls.	.....	Under Constr.	3rd Qtr., 1957	.....	.....	.....
		Distillation	80,000 bbls.	.....	Projected	2nd Qtr., 1957	.....	.....	.....
Creole Pet. Corp . .	Amuay Bay	Pipe Still	70,000 bbls.	$10,800,000	Under Constr.	.....	.....	Foster Wheeler	Foster Wheeler
*Creole Petroleum....	Amuay Bay	Lube Hydrofiner	.....	.....	Engineering	.....	.....	Foster Wheeler	Foster Wheeler
		Phenol Extraction Unit, Propane Dewaxing Plt., Lube Handling							
Richmond Exploration	Maracaibo	Asphalt Plt.	10,000 bbls.	$4,000,000	Under Constr.	.....	.....	.....	.....
*Venesuelan Govt.....	Venesuela	Ammonia Synthesis Gas	120 tons	$1,000,000	Planning	1957	.....	Air products	Air Products
Venesuela Gulf	Puerto La Cruz	Fluid Catalytic Cracking	8,000 bbls.	.....	Complete	.....	Kellogg	Kellogg	Kellogg
EUROPE AND AFRICA									
Belgium									
Esso.....	Antwerp	Exp. Ref.	.....	.....	Under Constr.	.....	.....	.....	.....
Petrochim.....	Antwerp	Ethylene Oxide, Ethylene Glycol	.....	$8,000,000	Engineering	.....	SDC	SDC	.....
Raf Belge de Petroles	Antwerp	Cat. Reformer	2,500 bbls.	$2,000,000	Engineering	Mid 1957	Sinclair-Baker	KIC	KIC
		Desulfurisation	.....	.....	Engineering	.....	Sinclair-Baker	KIC	KIC
Soc. Industrielle Belge de Petrolee	Antwerp.	Ref. Exp.	70,000	.....	Under Constr.	Early 1957	.....	SIBP: Kellogg	Kellogg
		Ref. Exp.	85,000	.....	Planning	1957	.....	Kellogg	Kellogg
		Cat Reformer	10,000 bbls.	.....	Under Constr.	1958	.....	Kellogg	Kellogg
		Hydrofiner	10,000 bbls.	.....	Under Constr.	1958	.....	Kellogg	Kellogg
Denmark									
A. P. Moeller.....	Copenhagen	Refinery	.....	$11,500,000	Planning	.....	.....	.....	.....
Egypt									
Anglo-Egyptian Oilfields	Sues	Cat. Reformer	2,300 bbls.	.....	Projected	3rd Qtr. 1957	.....	.....	.....
Egyptian Government	Cairo	Topping	40,000 bbls.	$3,000,000	Complete	.....	.....	.....	.....
*Egyptian Govt.....	Sues	Crude Distil.	20,000 bbls.	$1,200,000	Completed	.....	.....	Lummus	Lurgi, Germany
	Sues	Thermal Crk. Reforming Cat. Poly	3,000 bbls.	$1,800,000	Completed	.....	C R C	Lummus	Lurgi, Germany
	Sues	Boiler House	1,200 tons	$720,000	Completed	.....	.....	Walther Co. Germany	Walther, Germany
	Sues	Kerosene Refiner	5,000 bbls.	$180,000	Completed	.....	.....	Uhde Germany	Uhde Germany
	Sues	Power Plt.	10,000 KW.	$2,100,000	Planned	1958	.....	Italian	Firms
	Sues	Mech. Workshop	.....	$860,000	Planned	March, 1957	.....	.....	Local
	Sues	Cooling Tower & Accessories	120,000 tons	$250,000	Under Constr.	March, 1957	.....	Local	Local
	Sues	Atmos. Dist., Voc. Dist. & Lube Oils	20,000 bbls.	$6,000,000	Planning	.....	.....	.....	.....
	Sues	Vapor Recovery & Bottling	70 tons	$1,000,000	Planned	Dec., 1957	.....	Lummus	Lummus
England									
Berry Wiggins & Co., Ltd.	Weaste Ref., Manchester.	Extension to Refinery	500 bbls.	.....	Under Constr.	.....	.....	H.W.P.	H.W.P.
South Eastern Gas Board	Isle of Grain	Oil Gasification	15 Mmcf	.....	Under Constr.	Fall, 1958	.....	Power Gas	Power Gas
British Petroleum....	Kent	TWC Hydrofiners	10,000 bbls. ea.					KIC, S&W	McAlpine, Winpey
British Petroleum....	Kent	Alkylation Plt.	2,600 bbls.					.....	.....
British Petroleum....	Kent	Distillation Unit	90,000 bbls.	$73,000,000	Under Constr.	Late 1957		Badger, E.B. Badger, Ltd.	
		Platforming	10,000 bbls.					UOP, Lummus	
		Thermal Reforming	12,000 bbls.						
British Petroleum.....	Kent	Armonatic Recovery; Iso Pentane Fractionation; Depropanizer; Iso Pentane Washer	.....	.....	Engineering	.....	.....	S&W Badger Div., E. B. Badger, Ltd.	.....
Esso Petroleum Co...	Fawley	Refinery Expan.	†35,000 bbls.	$14,300,000	Under Constr.	.....	.....	Esso	Foster Wheeler
		Hydrofining	12,000 bbls.		Under Constr.	.....	.....	.....	.....
Hedon Chemicals.....	Hedon, Yorks.	Vinyl Acetate	.....	.....	Under Constr.	.....	.....	.....	.....
Imperial Chemicals...	Billingsham	Ammonia Plt.	200 tons	.....	Planning	.....	Texaco	Imperial	Imperial
Imperial Chemical Industries	Billingsham	Alcohols	†40,000 tons/yr.	.....	Engineering	.....	.....	Staff	.....
Imperial Chemical Industries	Wilton	Chemical Plt.	30 tons	.....	.....	.....	.....	S & W Badger Div.	E. B. Badger & Sons, Ltd.
Imperial Chemical Industries	Wilton	Butadiene Separation Plt.	6/7000 ton/yr.	.....	Design	.....	.....	H.W.P.	.....
Imperial Chemical Industries	Wilton	Extension of Cracker	†250,000 tons/yr.	.....	Complete	.....	.....	Staff and Kellogg	KIC

Construction Box Score Continued on Page 253

Gulf Oil Corporation uses Stainless in one of the world's largest cat crackers to withstand 1100° F. temperature



One of the largest catalytic crackers in the world, at Gulf Oil Corporation's Philadelphia refinery. Regenerator at left produces about 64,000 barrels per day.

IN ITS PHILADELPHIA REFINERY, Gulf operates one of the world's largest catalytic cracking units. It produces high octane gasoline, heating oils, fuel gas, gas oil, propane-propylene and butane-butylene. Capacity is about 64,000 barrels per day. 9 million pounds of catalyst circulate each hour, and the unit consumes nearly 400,000 pounds of steam per hour.

The top of the spherical regenerator is shingled with 14-gage Stainless Steel strip. Temperature reaches about 1100° F. in the burning atmosphere, and the Stainless Steel shingles resist erosion caused by the pressure circulation of the catalyst, which has the consistency of talcum powder. Carbon steel shingles would deteriorate and fail rapidly. Bottom section and cone of the fractionating tower (right) are lined with Stainless Steel to withstand corrosion at high (700° F.) temperature.

Stainless Steel gives you the most for your money when it is designed *into* equipment, right from the start. So think of Stainless Steel when you design. Think of *USS* Stainless when you buy.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALABAMA
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS STAINLESS STEEL

SHEETS • STRIP • PLATES
BARS • BILLETS

USS

PIPE • TUBES • WIRE
SPECIAL SECTIONS

UNITED STATES STEEL

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
International Synthetic Rubber	Fawley	Synthetic Rubber	50,000 ton/yr.	$12,000,000	Engineering	1957	.....	Blaw Knox	Blaw Knox
*Mobil Oil Co., Ltd..	Coryton	Cat. Hydrodesulfurization	.....	.....	Pre-engineering	.....	.....	.....	.....
		Crude Unit Exp.	.....	.....	Pre-engineering	.....	.....	.....	.....
Monsanto Chemicals	Britain	Add Polystyrene	.....	.....	Under Constr.	.....	.....	Staff	Staff
Monsanto Chemicals	Britain	Styrene-Butadiene Copolymer Plt.	4,000 tons/yr.	$14,000,000	Planned	.....	.....	.....	.....
Petrochemicals.....	Partington	Inc. Ethylene Oxide, Glycol Ether Polyglycols	To 25,000 tons/yr.	.....	Complete	.....	.....	CTIP	.....
Philblack.....	Avonmouth	Carbon Black Plt.	85 tons	.....	Complete	.....	.....	E.B.Badger, Ltd.	E.B.Badger, Ltd.
Regent Oil.....	Southern England	Refinery	.....	.....	Planning	1958	.....	.....	.....
Shell Chemical.....	Shell Haven	Ammonia; Nitric Acid Fertilizer	75,000 tons/yr.	$18,500,000	Planning	1958	.....	.....	.....
			.....	$12,500,000	Planning	.....	.....	.....	.....
*Shell Chemical.....	Partington	Ethylene Oxide	25,000 tons/yr.	.....	.....	Mid. 1958	.....	.....	.....
Shell Refining.....	Shell Haven	Atmospheric Distillation	80,000 bbls.	.....	Engineering	Late 1958	.....	S&W Badger Div., E. B. Badger, Ltd.	E. B. Badger, Ltd.
Finland									
Neste Oy Corp.....	Turku, Finland	Refinery	14,000 bbls.	$17,500,000	Planning	.....	Atlantic, Soc. Mob., Calif. Res.	.....	.....
France									
Antar Petroles de l'Atlantic	Donges	Cat. Reformer	13,000 bbls.	.....	Under Constr.	.....	Houdry, U.O.P.	Hydrocarbon, Hydro M.	Staff
*Bassin de Lorraine...	Carling	StyreneMonomer	.....	.....	.....	.....	.....	S.B.A.	S.B.A.
Cabot of France.....	Berre Lake	Carbon-Black Plt.	.....	.....	Planning	1957	.....	.....	.....
Caltex S.D.F.....	Ambes	Cat. Crker.	4,600 bbls.	.....	Under Constr.	1957	.....	Lummus	Lummus
		Vacuum Unit	6,300 bbls.	.....	Under Constr.	1957	.....	.....	Lummus
		Poly Plt.	540 bbls. (Product)	.....	Under Constr.	1957	C.R.C.	Foster Wheeler	Lummus
Comp. de Raffinage Shell Berre	Petit Couronne	Feed Prep.	20,000 bbls.	.....	Complete	.....	.....	S & W Badger Div. E. B. Badger, Ltd.	.....
Comp. Francaise de Raffinage	Gonfreville	Refinery Expan.	.....	.....	Complete	.....	.....	Kellogg	KIC
Comp Francaise de Raffinage	Provence	Desulfurization	.....	.....	.....	.....	.....	KIC	KIC
Esso Standard.....	Girdonde-Bordeaux	Refinery	31,500 bbls.	.....	Planning	1959	.....	.....	.....
Esso Standard.....	Port Jerome	Cat. Cracker	10,000 bbls.	$11,000,000	Planning	Early 1957	.....	.....	.....
Francolor.....	France	Maleic-Anhydride	.....	.....	Engineering	.....	SDC	.....	.....
*Mobil Oil Francaise..	Gravenchon	Cat. Hydrodesulfurization	.....	.....	Engineering	Sept., 1957	.....	Staff	.....
		Lube Expansion	.....	.....	Pre-engineering	.....	.....	.....	.....
Naphtachimie.....	Lavera	Exp. Ethylene Oxide	.....	.....	Under Constr.	1957	SDC	S&W Badger Div.	.....
*Naphtachimie.....	Lavera	Expand Ethylene	.....	.....	Under Constr.	1957	.....	S&W, E.B. Badger, Ltd.	.....
Pechiney.....	St. Auban	Perchlorethylene Plt.	.....	.....	Planning	.....	SDC	SDC	.....
Potasse et Engrais Chimiques	Grand Couronne	Ammonia	.....	.....	.....	.....	SBA	KIC	KIC
Societe du Caoutchoue Butyl	Le Havre	Synthetic Rubber Plt.	20,000 tons/yr.	.....	Engineering	Mid 1958	ESSO	.....	.....
Soc. Francaise des Petroles BP	Dunkirk	Cat. Reformer	10,000 bbls.	.....	Planning	Early 1958	.....	.....	.....
Soc. Francaise des Petroles BP	Lavera	Distillation	50,000 bbls.	.....	Under Constr.	Late 1957	.....	.....	.....
Soc. Nationale des Petroles D'Aquitaine	Lacq	Sulfur Recovery	.....	.....	Planning	.....	.....	Parsons	Parsons
Soc. Rhone-Poulence..	Gonfreville	Polyethylene	.....	.....	Licensed	.....	Phillips	.....	.....
Societe Rhone-Poulence	France	Polyethylene	.....	.....	Engineering	.....	SDC	.....	.....
West Germany									
Badische Aniline und Soda Fabrik	Ludurigshafen	Polyethylene	.....	.....	Licensed	.....	Phillips	.....	.....
Benzin und Petroleum.	Hamburg	Hydrofiner	6500 bbls.	.....	Under Constr.	Early 1957	.....	.....	.....
Buna Werke Huls G.m.b.H.	Marl, Kreis Recklinghausen, Western Germany	Synthetic Rubber Plt.	45,000	$27,000,000	Considering	Summer 1958	Esso R&E; Houdry; Firestone	Staff	Staff
Deutsche Vacuum Oil	Brenen-Osleb-shausen	Sovaformer	3,200 bbls.	.....	.....	.....	.....	.....	.....
		Sovafiner	4,800 bbls.	.....	Under Constr.	1957	Socony Mobil	.....	.....
		Sulfur Plt. Distillation							
*Deutsche Shell.....	Harburg	Cat. Reformer							
		Crude Distiller							
		Cat. Reformer	37,000 bbls.	.....	Under Constr.	End 1958	.....	.....	.....
		Hydrodesulfurization							
Esso.....	Cologne	Refinery	60,000 bbls.	.....	Planning	1959	.....	.....	.....
Etablissements Kuhlmann	.....	Ammonia Plt.	60 tons	.....	.....	.....	Texaco	Kuhlmann	Kuhlmann
Kohle-Oil Chemie....	Gelsenkirchen	Polyethylene	24,000 ton/yr.	.....	Planning	.....	.....	.....	.....
*Mobil Oil A.G.....	Bremen	Cat. Reforming	.....	.....	Under Constr.	1st Qtr., 1957	.....	Braun	.....
		Cat. Hydrodesulfurization	.....	.....	Under Constr.	1st Qtr., 1957	.....	Braun	.....
		Crude Two Stage	.....	.....	Pre-engineering	Dec., 1957	.....	.....	.....
Ruhrbau.....	Mulheim	Refinery	15,000 bbls.	.....	Planning	.....	.....	.....	.....
Socony Mobil.....	Bremen	Hydrodesulfurization	5,500 bbls.	.....	.....	.....	.....	Braun	Braun
Greece									
Greek Government...	Pireaus	Refinery	30,000 bbls.	$15,000,000	Under Constr.	1st Qtr., 1957	Atlantic	Hydrocarbon	Hydro. M, Krupp, Stahlunion, Stahlbau
Ireland									
Eric Government Esso Petr. (Ireland) Caltex (Ireland) Irish Shell	Whitegate	Refinery	32,000 bbls.	$33,600,000	Approved	.....	.....	.....	.....

Construction Box Score Continued on Page 255

"STOP the work!
... Advertising wants a picture"

This central-section view of our Main Shop is partial evidence of facilities which, though complete in plant and field, are overshadowed by an intangible reason for your interest. Namely, our 58 years' specialized experience in prefabricating and installing high-temperature, high-pressure piping. On your next job . . . ask us in.

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MITCHELL PIPING
SINCE 1899

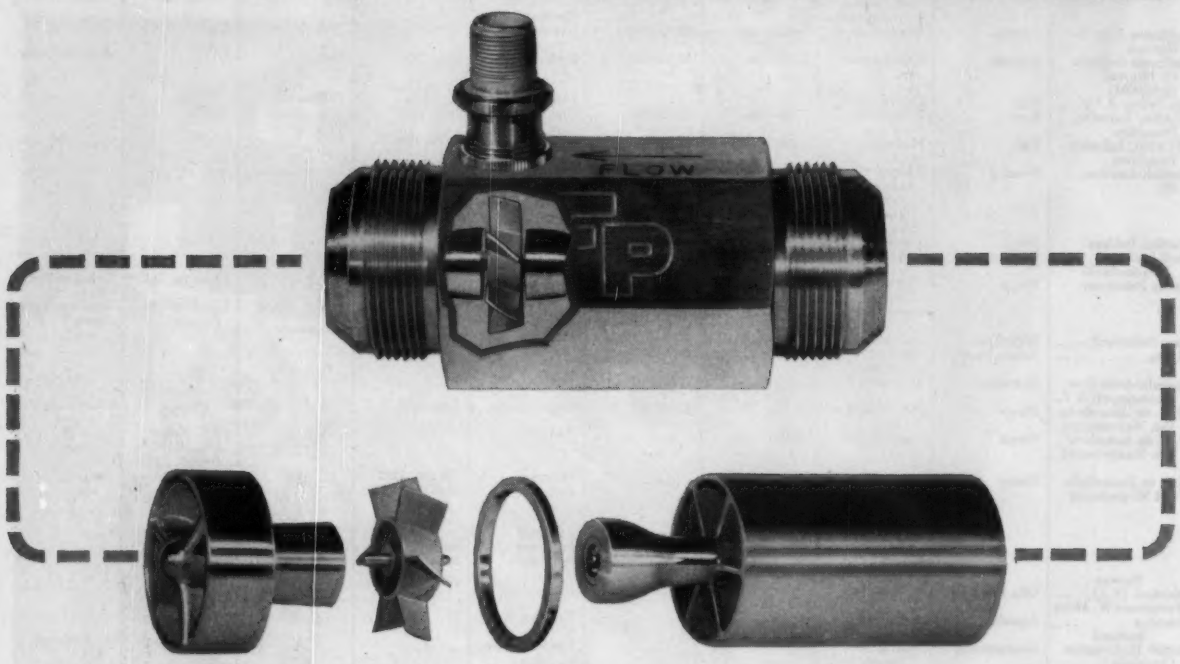
PIPING FABRICATORS AND CONTRACTORS

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Italy									
Ente Nazionale Idrocarburi	Ravenna	Butadiene Plt.	30,000 tons a yr. Rubber	75,000,000	Under Constr.	1957	.....	Union Carbide Carbon;	Brown-Root
		Copolymer Plt.	350,000 tons a year		Under Constr.	1957	.....	Phillips Petroleum	Brown-Root
		Ammonia; Fertilizers	.....	.....	.....	1957	.....	.....	.....
Golfo Industria Petrolifera S.P.A.	Gaeta, Italy	New Refinery	15,000 bbls.	.....	.....	.....	.....	Teenider	.....
*Mobil Oil Italiana S. p.a	Naples	Cat. Reforming	.....	.....	Pre-engineering	Jan., 1958	.....	.....	.....
		Cat. Hydrodesulfurization	.....	.....	Pre-engineering	.....	.....	.....	.....
		Lube Expansion	.....	.....	Pre-engineering	.....	.....	.....	.....
Raffineria Dott. E. Garrone	Genova	Ultraformer	5,000 bbls.	$2,000,000	Complete	.....	Esso	CTIP	.....
Raffineria Siciliana Oli Minerali (RASIOM)	Augusta	Powerformer	7,500 bbls.	$2,000,000	Under Constr.	Oct., 1957	Esso	CTIP	Bonaldi-Crema
Soc. Solvay & Cie....	Italy	Polyethylene	.....	.....	Licensed	.....	Phillips	.....	.....
STANIC Industria Petrolifera	Bari	Powerformer	7,300 bbls.	$3,400,000	Under Constr.	July, 1957	Esso	CTIP	.....
*STANIC Industria Petrolifera	Bari	Hydrofiner	8,200 bbls.	$850,000	Planning	April, 1958	Esso	.....	.....
Turkish-American Oil	Istanbul	Refinery; Crude-Vacuum; Cat Cracker, Vapor Recovery, Cat Poly, Treating	15,000 bbls.	$12,000,000	Approved	Aug., 1958	.....	.....	.....
Purifina Italiana	Milan	Distillation Unit	†5,000 bbls.	.....	Planning	.....	.....	.....	.....
Shell Italiana.....	Palermo	Refinery	20,000 bbls.	.....	Planning	.....	.....	.....	.....
Netherlands									
Caltex Petroleum	Pernis	Platformer Unifiner	7,000 bbls.	.....	Under Constr.	1957	U.O.P.	Lummus, Ltd.	Lummus-Werkspoor
		Desulfurization	4,000 bbls.	.....	Under Constr.	1957	U.O.P., Union	Lummus, Ltd., Parsons	Lummus-Werkspoor
Esso Nederland.....	Rotterdam	Refinery	40,000 bbls.	$29,000,000	Planning	Early 1960	.....	.....	.....
Mekog.....	Velsen-Ymuiden	Nitrigen Fertilizer	.....	$9,000,000	Planning	.....	.....	.....	.....
Nederlandsche Dow Maatschappij N.V.	Rotterdam	Processing Plt.	.....	.....	Under Constr.	.....	.....	.....	.....
N. V. de Bataafsche Pet. Maatschappij	Pernis	Syn. Glycerine	.....	$7,000,000	Under Constr.	Late 1957	.....	.....	.....
N. V. de Bataafsche Pet. Maatschappij	Pernis	Vacuum Still	66,000 bbls.	.....	Complete	.....	.....	S&W Badger Div., E. B. Badger, Ltd.	.....
N.V. de Bataafsche Pet Maatschappy	Pernis	Cat Reformer	12,700 bbls.	.....	Projected	3rd Qtr. 1957	.....	.....	.....
		Hydrodesulfurirer I	16,400 bbls.	.....	Projected	3rd Qtr., 1957	.....	.....	.....
		Hydrodesulfuriser II	7,800 bbls.	.....	Projected	3rd Qtr., 1957	.....	.....	.....
		Cycle Oil	7800 bbls.	.....	Projected	3rd Qtr. 1957	.....	.....	.....
		Gasoil	16,400 bbls.	.....	Projected	3rd Qtr. 1957	.....	.....	.....
Norway									
Standard (N.J.).....	Oslo Fjord	Refinery	.....	.....	Negotiating	.....	.....	.....	.....
Portuguese W. Africa									
Petrofina.....	Luanda	Refinery	.....	.....	Planning	.....	.....	.....	.....
Scotland									
British Hydrocarbon Chemicals	Grangemouth	Additional Cracking	.....	.....	Under Constr.	.....	.....	S&W Badger Div.	E. B. Badger, Ltd.
		Gas-Separating	.....	.....	Under Constr.	.....	Shell	S&W Badger Div.	E. B. Badger, Ltd.
		Ethanol, Ethylene, Tetrapropylene		$13,000,000	Under Constr.	Early 1957	UOP	S&W Badger Div.	E. B. Badger, Ltd.
		Butadiene	.....	.....	Under Constr.	.....	.....	KIC	KIC
Spain									
*British Hydrocarbons	Grangemouth	Polyethylene Plt.	25,000,000 tons/yr.	.....	Engineering	Phillips	.....	.....	.....
Refineria de Petroleos de Escombreras S.A.	Escombreras	Topping Unit	25,000 bbls.	.....	Under Constr.	1957	.....	Foster Wheeler	Foster Wheeler
		Platformer	8,000 bbls.	.....	Under Constr.	1957	UOP	Foster Wheeler	Foster Wheeler
*Repesa.....	Escombreras (Cartagena)	Topping Unit	25,000 bbls.	.....	.....	.....	.....	.....	.....
		Platformer	11,000 bbls.	.....	.....	.....	.....	.....	.....
		LPG Unit Offsite Facil.	.....	$10,000,000	Under Constr.	March, 1957	UOP	Foster Wheeler	Foster Wheeler
Sweden									
Johnson Line Trieste	Gothenburg	Refinery	2,500 bbls.	.....	Planned	.....	.....	Staff	Staff
S.P.A. Tecnico Industriale Aquila	Trieste	Cat. Cracking	3,300 bbls.	.....	Under Constr.	.....	Soc.-Vac.	Staff	Staff
		Cat. Poly.	1,400 bbls.	.....	Under Constr.	.....	U.O.P.	Staff	Staff
Turkey									
Badische Anilin and Soda Fabrik	Kutefia	Ammonium Sulfate	60,000 tons/yr.	$20,000,000	Planning	1958	.....	.....	.....
		Sulfuric, Nitric Acid	50,000 ton/yr.						
Turkish Governm't...	Istanbul	Nat. Gaso. Plt.	.....	.....	Planning	.....	.....	.....	.....
Union of South Africa									
Union Petrol Refinery, Ltd.	Johannesburg	Refinery	.....	$20,000,000	Projected	.....	.....	.....	.....
NEAR EAST									
Aden									
British Petroleum.....	Aden	Thermal Reformer	12,000 bbls.	.....	Under Constr.	1958	.....	KIC	Bechtel
Bahrain									
Bahrain Petroleum....	Bahrain	Platformer	10,000 bbls.	.....	Under Constr.	1957	.....	Foster Wheeler	Foster Wheeler
Iraq									
Iraq Government.....	Iraq	Lube Oil Plt.	25,000 ton/yr.	.....	Planning	.....	.....	Foster-Wheeler	Foster-Wheeler
Jordan									
*Iraq Government....	Daura	Refinery Expan.	50,000 bbls.	$10,000,000	Planning	Late 1958	.....	.....	.....
Jordanian Reconstruction Council	Mafrak	Refinery	.....	$7,500,000	Planned	.....	.....	.....	.....
Kuwait									
Kuwait Oil.....	Mina alAhmadi	Two Distillation Units	80,000 bbls. each	.....	Under Constr.	End 1957	.....	S&W Badger Div., E. B. Badger;Bechtel	Bechtel
Saudi Arabia									
Arabian American	Ras Tanura	Asphalt Plt.	1,250 bbls.	.....	Under Constr.	1956	.....	.....	.....
Arabian American Oil Co.	Ras Tanura	Hydrofiner	15,000 bbls.	$4,100,000	Under Constr.	Spring, 1957	Esso	Lummus	Lummus
Saudi Arabian Government	Saudi Arabia	Ammonium Sulfate Plt.	400,000 Metric tons/yr. Plus 500 Tons Dry Ice	.....	Proposed	.....	.....	.....	.....

Construction Box Score Continued on Page 257

The big difference is inside the NEW F&P TURBINE METER



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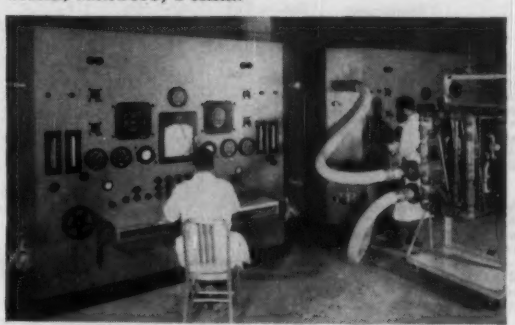

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REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

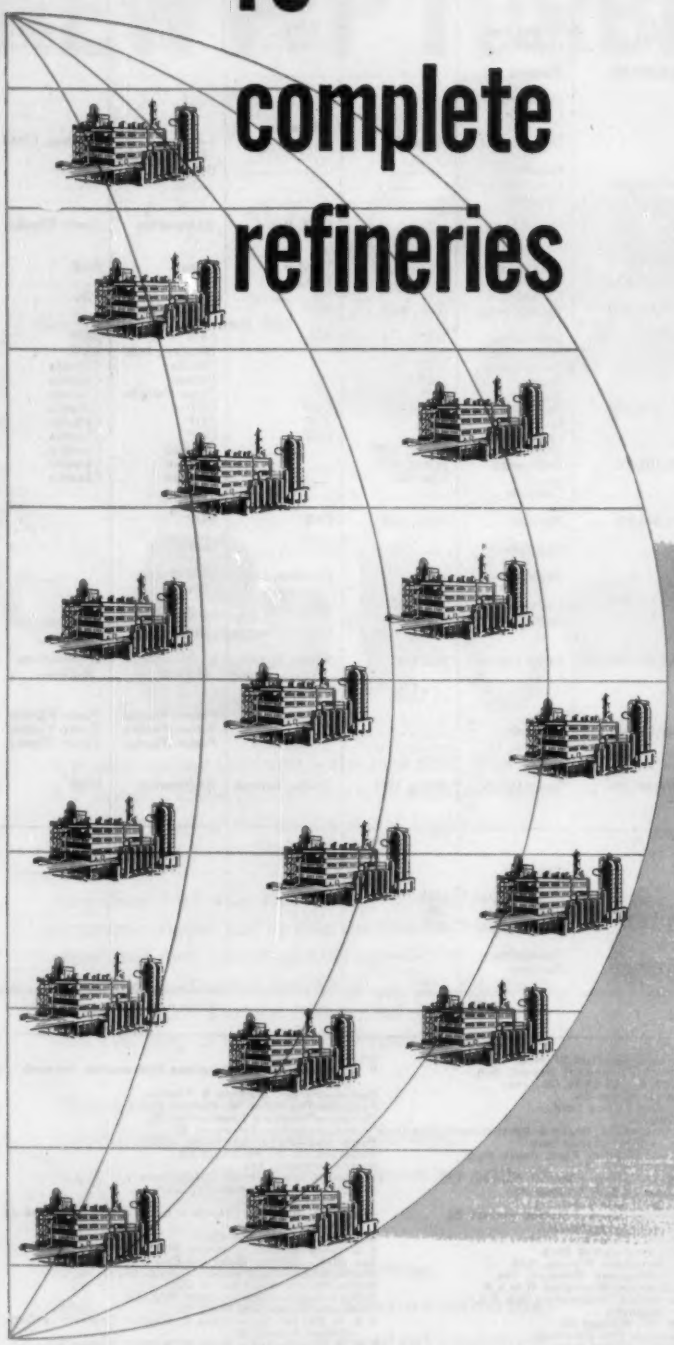
COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Syria									
Esso Standard	Syria	Refinery	10,000 bbls.	.....	Proposed	.....	.....	.....	.....
Syrian Government	Homs	Refinery	12,000 bbls.	$3,000,000	Considering	.....	.....	.....	.....
FAR EAST									
Burma									
Burmah Oil	Syriam	Refinery	.....	.....	Under Constr.	.....	.....	.....	.....
Burmah Oil	Chauk	Auxiliary Fac.	.....	.....	Under Constr.	.....	.....	.....	.....
Ceylon									
Shell of Ceylon	Hendola	Refinery	.....	$40,000,000	Planning	.....	.....	.....	.....
India									
Assam Oil	Assam	Refinery	.....	.....	Considering	.....	.....	.....	.....
Burmah-Shell	Bombay	Cat. Reformer	6,700 bbls.	.....	Complete	.....	.....	.....	.....
		Edeleanu Plt.	7,300 bbls.	.....	Complete	.....	Edeleanu	.....	.....
Caltex Oil Refining (India) Ltd.	Visakhapatnam	Refinery	13,500 bbls.	.....	Under Constr.	Early 1957	.....	Lummus Foster Wheeler	Lummus, CB&I
Dow et al	Bombay	Polystyrene Plt.	2,700 ton/yr.	.....	Engineering	.....	.....	Bechtel	Bechtel
Indian Gov't.	Bhavnagar	Refinery	30,000 bbls.	$42,000,000	Considering	.....	.....	.....	.....
Indian Government	India	Synthetic Petroleum Plt.	6,000 bbls.	.....	Planning	.....	.....	.....	.....
Standard Vacuum	Bombay	Cat. Polymerization	350 bbls.	.....	Complete	.....	Calif. Res.	Hydrocarbon	Foster Wheeler
Japan									
Daikyo Oil	Yokkaichi	Houdriformer	3000 bbls.	.....	Under Constr.	Summer 1957	Houdry	Treco	Staff
Idemitsu Kosan Co.	Tokuyama	Refinery	30,000 bbls.	$25,000,000	Under Constr.	1957	U.O.P.	.....	.....
Marusen Oil Co.	Japan	Petrochemicals	.....	.....	Unconfirmed	.....	.....	.....	.....
Mitsui Petrochemical Industries	Iwakuni City	Ethylene Oxide	.....	$30,000,000	Under Constr.	Nov., 1957	SDC	S&W Badger Div.	.....
		Ethylene Glycol							
*Mitsui Petrochemical Industries	Iwakuni City	Ethylene Unit, Phenol Unit	.....	.....	Engineering	1957	.....	S&W	S&W
			.....	.....	Engineering	1957	.....	Distillers, Ltd.	S&W
*Mitsubishi Oil Co., Ltd.	Kawasaki	Crude Unit	25,000 bbls.	.....	Under Constr.	1957	.....	Chitida	Chiyoda
		Crude Desalter	25,000 bbls.	.....	Engineering	1957	.....	Petreco	Chiyoda
		Copper Sweetner	3,500 bbls.	.....	Engineering	1957	.....	Union Carbide	Chiyoda
		Platformer	3,000 bbls.	$13,700,000	Engineering	1958	UOP	UOP	Chiyoda
		Unifiner	12,500 bbls.	.....	Engineering	1958	UOP	UOP	Chiyoda
		Udex	750 bbls.	.....	Engineering	1958	UOP	UOP	Chiyoda
Nihon Gas Kagaku Kogyo	Niigata	Urea	905 tons	$2,100,000	Engineering	Spring, 1957	.....	Chemico	Chemico
		Ammonia	100 tons			Spring, 1957	.....	Chemico	Chemico
		Ammonia Sulfate	200 tons			Late 1957	.....	Chemico	Chemico
Nippon Petroleum Refining	Yokohama	Topping Unit	22,500 bbls.	.....	Complete	.....	.....	Staff	.....
*Nippon Petroleum Refining	Yokahoma	Unifiner—Platformer	3,300 bbls.	$2,500,000	Planning	Sept., 1957	UOP	UOP	.....
Nippon Petroleum Refining	Kudamatsu	Crude Unit	16,500 bbls.	.....	Complete	.....	.....	Staff	.....
Nippon Petrochemicals	Kawasaki	Isopropyl Alcohol; Acetone	.....	.....	Engineering	1957	Distillers, Ltd.	S&W Badger, Div.	.....
*Showa Oil Co.	Yokkaichi	Refinery	40,000 bbls.	.....	Under Constr.	Dec., 1957	.....	.....	.....
Sunitomo Chemical	Japan	Ethylene Unit	.....	.....	Engineering	1957	.....	S&W Badger Div.	.....
Korea									
Korean Government	Chung-ju	Urea Plt.	185 tons	$25,000,000	Under Constr.	Mid 1957	Vulcan, Inventa, Texaco, Hydrocarbon	Hydrocarbon, McGraw	Hydrocarbon, McGraw
Sumatra									
Standard-Vacuum	Palembang	Cat. Cracker	11,000 bbls.	$20,000,000	Planning	.....	.....	Foster-Wheeler	Foster-Wheeler
		Polymerization	1,200 bbls.			.....	.....	Foster-Wheeler	Foster-Wheeler
		Revamp Existing Plt.	.....			.....	.....	Foster-Wheeler	Foster-Wheeler
Formosa									
Taiwan Fertiliser, Ltd.	Nankong	Ammonia Plt. to Produce Urea	200 tons	$18,000,000	Under Constr.	Spring, 1957	Vulcan, Inventa	Hydrocarbon	Staff
AUSTRALASIA									
Australia									
Bitumen & Oil Refineries	Sydney	Crude Unit	9,000 bbls.	.....	Complete	.....	.....	.....	.....
Bitumen & Oil Refineries	Queensland	Crude Unit	5,000 bbls.	.....	Under Constr.	1957	.....	.....	.....
		Platformer	1,500 bbls.	.....	Under Constr.	1957	.....	.....	.....
		Desulfurisation	1,500 bbls.	.....	Under Constr.	1957	.....	.....	.....
Phillipine Islands									
Shell (Philippines)	Manila	Refinery	.....	.....	Negotiating	.....	.....	.....	.....
Standard-Vacuum	Manila	Refinery	21,000 bbls.	$35,000,000	Planning	.....	.....	.....	.....

* First appearance in tabulation † Added capacity

NOTE:

Armistead—George Armistead & Co.
Atlantic—Atlantic Ref. Co.
Austin—Austin Co.
Badger Mfg.—Badger Manufacturing Co.
Badger N. V.—Badger-Comprimo N. V.
E. B. Badger Ltd.—E. B. Badger & Sons Ltd.
E. B. Badger Pty.—E. B. Badger & Sons Pty., Ltd.
Barnes—W. M. Barnes Co.
Bechtel—Bechtel Corp.
Beck—Henry C. Beck
Blaw-Knox—Blaw-Knox Co.
Braun—C. F. Braun Co.
Breda—Breda Electromaconia Locomotive
Brown & Root—Brown & Root Construction Co.
Buckner—F. J. Buckner Corp.
Calif. Res.—California Research Corp.
Can. Kellogg—Canadian Kellogg Co.
Cat. Constr.—Catalytic Construction Co.
Chemico—Chemical Construction Co.
Ch. Pro.—Chemical Process, Inc.
C. B. & I.—Chicago Bridge & Iron Co.
Chiyoda—Chiyoda Chemical Engineering & Construction Co., Ltd.
C. & I.—Chemical & Industrial Corp.
Consd. Eng.—Consolidated Engineering Company
Craig—A. F. Craig & Co.
C.T.I.P.—Compagnia Tecnica Industria Petroli
D & Z—Day & Zimmerman
Delta—Delta Engineering Corp.
Dresser—Dresser Engineering Corp.
Ebasco—Ebasco Services, Inc.
E&A—Ehrhart & Arthur, Inc.
Esso—Esso Research and Engineering Co.
Edeleanu—Edeleanu Gesellschaft M.B. H.
Etabadger, S.A.—Etablissement Badger, S.A.
F&C—Farnsworth & Chambers Co., Inc.
Ferguson—H. K. Ferguson Co.
Fish—The Fish Engineering Corp.
Fluor—Fluor Corp.
Ford, Bacon, Davis—Ford, Bacon & Davis Construction Corp.
Foster Wheeler—Foster Wheeler Corp.
Gas Plant Constr.—Gasoline Plant Const. Corp.
Girdler—The Girdler Co.
Girdler (Canada)—Girdler Corp. of Canada, Ltd.
Graf—Graff Engineering & Equipment
Graver—Graver Construction Co.
Grebe & Doremus—Grebe & Doremus Process Co.
Gutte-Hutte—Gutehoffnungshuette
Hercules—Hercules Powder Co.
Hudson—Hudson Engineering Corp.
H.W.P.—Head Wrightson Process, Ltd.
Hydrocarbon—Hydrocarbon Research, Inc.
Hydro M—Hydrocarbon Minerzloet G.m.b.H.
Hydro E—Hydrocarbon Engineering S.A.R.L.
Kaiser—Kaiser Engineers
Kellogg—The M. W. Kellogg Co.
Kellogg P A—Kellogg Pan American
KIC—Kellogg International Corp.
Kidde—Walter Kidde Engineers Southwest, Inc.
Koch—Koch Engineering Company
Koppers—Koppers Co., Inc.
Litwin—Litwin Engineering Co.
Lummus—The Lummus Co.
Macco—Macco Corp.
Mannix Gill—Mannix Gill, Ltd.
McGraw—F. H. McGraw & Co.
McKee—Arthur G. McKee Co.
M-C & S—Merritt-Chapman & Scott Corp.
Olsen—O. L. Olsen
P. A. HydroRes—Pan-American Hydrocarbon Research Co.
Parker—Parker, Steffens & Pearce
Parsons—The Ralph M. Parsons Co.
Petreco—Petroleum Construction Co.
Phillips—Phillips Petroleum Co.
Power Gas—Power Gas Corp., Ltd.
Pritchard—J. H. Pritchard Co.
Procon—Procon, Inc.
Quaker—Quaker Valley Constructors
Russell—Russell Engineering Corp.
Rust—Rust Engr. Co.
SBA—Soc. Belge de L'Azote et des Produits Chimiques du Hardy.
SDC—Scientific Design Co.
S & S—Singmaster & Breyer Separator-Nobel Co.
Soc. Mob.—Socony-Mobil Oil Co.
Southwestern—Southwestern Constr. Co.
Sohio—Standard Oil Co. of Ohio
Stearns-Roger—Stearns-Roger Mfg. Co.
Sunland—Sunland Refining Co.
S & W Badger Div.—Stone & Webster Engineering Corp., Badger Process Div.
S & W Canada Ltd.—Stone & Webster Canada Ltd.
Swco—Southwestern Engineering Co.
Texas—Texas Engineers
Tellepsen—Tellepsen Petro-Chem Constructors
Texaco Dev.—Texaco Development Corp.
Texaco—The Texas Co.
Texas Natural—Texas Natural Gasoline Corp.
Treco—Refinery Engineering Co.
Tuloma—Tuloma Builders
U.O.P.—Universal Oil Products Co.
Vucan—Vulcan Engineering Div.
J. G. White—J. G. White Eng. Corp.

16 complete refineries



1945

1. Refinery for B. P. M. at Cardon, Venezuela.
2. Refinery for Koppartrans Oljeaktiebolag at Gothenburg, Sweden.
3. Refinery for Venezuela Gulf Refining Company at Puerto La Cruz, Venezuela.
4. Refinery for Societe Generale des Huiles de Petrole at Dunkirk, France.
5. "Portable" refinery for U. S. Navy Department.
6. Lube oil refinery for Cit-Con Oil Corporation at Lake Charles, Louisiana.
7. Refinery for International Refineries Inc. at Wrenshall, Minnesota.
8. Refinery for Vacuum Oil Company Ltd. at Coryton, England.
9. Refinery for Burmah-Shell Oil Company at Bombay, India.
10. Refinery for Standard-Vacuum Oil Company at Bombay, India.
11. Refinery for Standard Oil Company (Indiana) at Mandan, North Dakota.
12. Refinery for Suntide Refining Company at Corpus Christi, Texas.
13. Refinery for Commonwealth Refining Company at Ponce, Puerto Rico.
14. Refinery for Esso Standard Oil Company at Antwerp, Belgium.
15. Refinery for Caltex at Visakhapatnam, India.
16. Refinery for Neste Oy at Turku, Finland.

1955

In the past 10 years alone, Lummus has completed or is currently working on 16 complete refineries. Combined, they represent a large percentage of the refinery capacity constructed in the last decade.

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ENGINEERS AND CONSTRUCTORS FOR INDUSTRY

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Summary of Crude Oil Characteristics

1. A low gravity crude oil may have either a high or low flash point, depending upon the flash point of the lightest ends.
2. A high gravity crude oil may have a low or high flash point, but most often has a low flash point.
3. As vapor pressure is governed not only by how low is the flash point of the lightest of hydrocarbons in the mixture, but also by the proportion of these low flash point hydrocarbons to the total mixture, a low flash point oil may have either a low or high vapor pressure, depending upon the proportion of the low flash point hydrocarbons to the higher ones. However, an oil with an appreciable vapor pressure always has a low flash point.
4. A low flash point oil at a temperature above its flash point, in open air will form the correct mixture and flash when flame or spark is applied near its surface and if the oil has a temperature above its firepoint, it will continue to burn. This is also true in a closed container of a low flash point oil if it also has a vapor pressure sufficiently low that the air is not purged from the surface area to below that required to form a burning mixture. If the vapor pressure is sufficiently high to purge the air, such as in case of gasoline and high vapor pressure crude oil, to below the air volume required in the mixture will be too rich to burn and will not become ignited near the surface in a closed container, nor higher up in a gas-tight container equipped with conservation vents or other such devices.
5. There is a relation between the boiling range of a crude oil and its characteristics to form a heat wave. The establishing of this heat wave and the rate of its travel into the surface of the oil is no doubt influenced by the impurities and free carbon in the crude oil and by the other characteristics described. It is well known, however, that refined oils with their narrower boiling ranges do not establish heat waves, and even when two or more of them are mixed back without impurities, tests show no heat wave establishing characteristics.
6. Since there are hundreds of crude oils differing in characteristics that influence their reactions to surface burning, each crude oil must be considered separately in the burning question of crude oil.
7. An oil that does not establish a heat wave will not boil over of slop over. Heat wave establishing characteristics have not been found on oils of sufficiently non-viscuous characteristics that the steam could pass through without boilover or slopover. It is safe to conclude that if an oil will establish a progressively deepening heat wave from surface burning, it does have boilover and slopover characteristics.
8. The heavy ends of crude oil which heat up from surface burning and drop toward the bottom of the tank do not penetrate to an appreciable depth the cold oil, but stop near its cold point, thus progressively pushing it downward.

What Is a Heat Wave? In the case of some very narrow boiling range crude oils (like all refined products) heat penetrates only a shallow surface layer from continued burning. In the case of the usual wide boiling range crude oils, the lower boiling point higher gravity hydrocarbons come out of the surface and feed the fire, while the high boiling point hydrocarbons sink toward the bottom or at least through the heated surface, forming a heated front to heat the cold oil deeper and deeper as the fire continues to burn. This is called a heat wave.

It is assumed that in the progressive heat wave of a burning crude oil tank, the light ends come off in quantity as long as any are present. This maintains the temperature of the heat waves at close to 300 F until the light ends are gone.

Actually the rise in temperature is probably progressive but in steps; as the light ends boil out and are consumed, there is less and less vapor space between the base of the flame and the surface of the oil, thus causing the surface temperature to rise rapidly when no more light ends are available for distillation.

As the temperature rises at the surface, distillation of heavier ends commences and the temperature of the heat wave in some crude oils may rise to as high as 600 F.

In the case of the burning tank, these heavy ends sink through the mixture of lighter hydrocarbons, and impurities, until they reach specific gravity equilibrium in the oil balance. Since they are hot, they give off some of their heat on their descent, thus distilling off some more light ends.

Thus the heat wave grows, based on heat input and vapor output, until all but the heavy ends are gone, or the heat wave reaches a water or emulsion layer and causes a steam explosion.

In some crude oils this deepening layer or heat wave travels downward into the oil only three inches per hour faster than the burn off, while in others it may travel as much as fifty inches per hour. In most crude oils, the rate is from twelve to eighteen inches per hour faster than the burn off.

Just what part the impurities in crude oils contribute

FIGURE 5—The application of foam to an 11-inch heat wave in this small tank shows how the steam bubbles form in the heat wave and expand it beyond the capacity of the tank in a slopover.

to the heat wave establishment and to the rate of its travel is not known. It is known, however, that crude oils from different fields with similar boiling ranges have wide differences in their heat wave rates of travel.

In spite of all that has gone before, there are still several questions respecting heat waves that have not yet been answered. For instance, we know that heated hydrocarbons drop toward the bottom of the tank as rapidly before the fire as during it? Do they only drop through the heated surface and bombard the top of the cold oil below or do they drop even into the cold oil? Apparently these heated heavy ends drop only to the cold front of the oil, thus giving off heat to it and deepening the heated layer so that the next group sinks a little deeper.

Rainy Day Heat Waves—It has been noted in tests that anything which takes heat from the heat wave retards its travel downward. During long tests on a day of showers and sunshine, during the showers, the heat wave travel practically stopped and would start again when the shower ceased. This brings up the question of the effect of a water content on the heat wave travel in crude oil.

Why does such a heat wave not form on refined oils? There may be several reasons, the chief of which is the narrower boiling range of the refined oil below. This refined oil below the surface is composed of a range of gravities sufficiently narrow and with few impurities so that there is not sufficient difference in the weight of the larger heated particle at the top to carry it down into the mass of oil and at a rate to deepen this heat layer faster than the burn off.

Tests reveal that this will not occur even in a mixture of refined products from which the impurities have been removed. Tests in which a mixture of cracked gasoline, kerosine, Number 2 fuel oil, and Number 6 fuel oil have been used and on which no heat wave was established, further indicate that perhaps the impurities, water content, other foreign matter, and perhaps free carbon, in crude oil has a greater influence on heat wave establishment and the rate of travel of such a heat wave than heretofore accredited.

BOILOVER AND SLOPOVER OF CRUDE OIL

The story of the heat wave establishing characteristics of some crude oils is incomplete unless mention is made of the characteristics of the oils to boilover or slopover because of the heat wave, viscuous character of the oil, the invariable presence of water in the tank and the water content of fire foam, the chief agent used to extinguish large low flash point cone roof tank fires.

It is common usage in fire protection regulations to classify tanks as those containing refined petroleum products or other flammable liquids not subject to boilover, and tanks containing crude petroleum. The National Fire Protection Association model ordinance formerly referred to the latter in terms of crude oil and other oils subject to boilover. After long experience of the oil industry and many tests, the phrase, "crude oil and other oils subject to boilover," has been deleted and the words "crude petroleum" used instead.

What is Boilover?—To illustrate the term "boilover,"

Meet the Author

J. L. RISINGER is making public for the first time the vast store of experience he has accumulated through 33 years of working in the field of safety and fire prevention. Now on assignment as advisor on fire protection to the Iranian Oil Refining Company, Abadan, Iran, Risinger recently retired from Socony Mobil Oil Company after 37 years of service. He is now a special consultant on safety and fire protection. Risinger's extensive research equips him to provide, especially to those handling and storing petroleum and its products, information that will be of great benefit to them. He has organized as many or more safety and fire protection programs as any other man—and these programs have been as successful and obtained as much result as any others that have been organized. Risinger is the inventor of the air agitation method of extinguishing and controlling to easier extinguish oil tank fires. Some of his new methods of controlling fires have never been published. They will be described as they fall into application in this series of articles. The author will answer any questions you may have regarding articles which appear in this series. Please direct your queries to J. L. Risinger, 13 Euclid Avenue, Maplewood, N. J.

it is only necessary to assume that the crude oil tank burning at the surface and establishing a progressively deepening heat wave or layer into the body of oil is permitted to continue burning until the heat wave reacts on water under the oil. Since the temperature of the oil in this heat wave ranges from 300 to 600 F, dependent upon the kind of crude oil and time of burning, it is inevitable that some of this water will be converted to steam, expanding approximately 1700 times and in accordance with the amount of water so converted and the depth of oil above it, piston a quantity of the burning oil out of the tank.

To have a boilover three things must be present. A heat wave that penetrates to water below the oil, the water to be converted to steam, and a viscuous oil through which steam cannot readily pass from below.

For a closer observation of the action of a boilover in Figure 4, the tank with no water in the bottom was permitted to burn until the heat wave reached the bottom of the tank. The fire was then extinguished with dry chemical, the steel above liquid level allowed to cool for thirty seconds to avoid re-ignition, and then water was pumped through a spreading device at the bottom of the tank. It will be noted, in this boilover without fire, that when the water under the oil is expanded into steam, some of the hot oil is not only formed into a froth of steam bubbles, but also some of the unfrother oil is thrown out of the tank by the steam power below.

What Is Slopover?—In the case of a slopover, the oil acts differently from that of a boilover. Although still dependent upon the heat wave and its depth, a slopover is usually man-made in his effort to extinguish the fire, sometime between the time of the establishment of a sufficient heat wave at the surface of the oil and the time at which the heat wave reached the water at the bottom of the tank.

While a boilover is both a frothing over and a throwing of the oil by the expansion of water to steam under the oil, a slopover is a frothing over of the heavy ends of the oil by the formation of steam bubbles in them when water sinks into the heat wave.

If water or fire foam, with a water base, is applied except sparingly to a heat wave, it sinks into the heat wave, and is expanded into steam. On its way out, the steam forms a froth or steam bubbles which expands the hot oil in the heat wave to a greater capacity than the outage of the container, in accordance with the depth of the heat wave and the outage of the container, and thus causes the froth to spill over the top of the container.

Reactions from Water or Foam—The question is often asked, "How deep must the heat wave be in order to have a slopover when water or foam is applied?" This varies, depending upon the outage of the container, the viscosity of the oil, and the rate of application of water or foam. For instance, some slopping can be caused on oils such as Number 6 fuel oil which does not have heat wave establishing characteristics. This can be done by filling a container to a level with the top with viscuous refined oil and igniting it.

Within 15 minutes, the heat layer at the surface will be about one and one-half inches in the small container, chiefly from heat of steel nearby, but which will not in-

FIGURE 6—Tank slopping over without fire. With an 11-inch heat wave, this tank was extinguished with dry chemical and then the foam applied to better observe the steam bubble expansion of the heat wave over the side of the tank.

FIGURE 7—Not having heat wave establishing characteristics, the very viscous Number 6 fuel oil does not slop over, regardless of how long it has burned at the surface.

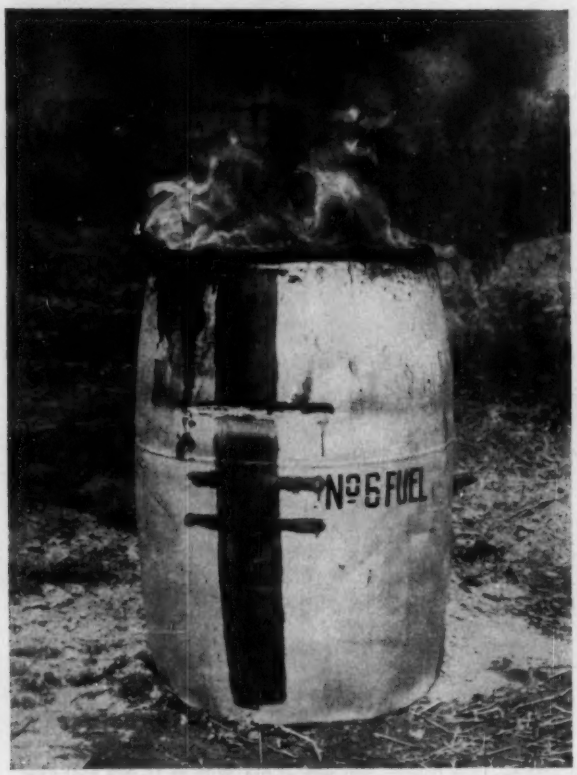


FIGURE 8—To determine if an oil has heat wave, boilover and slopover characteristics, allow a drum (such as the one shown above) to burn for at least one hour and observe the depth of change in color of heat detecting paint. Here the change was deeper because of the heat input from the shell of the small container above the liquid.

FIGURE 9—Crude oil is shown slopping over when foam is applied; likewise it would boil over if permitted to burn until the heat wave reached water under the oil.

crease regardless of how long it burns. At the end of 15 minutes the drum will remain practically full so that the expansion even of the thin heated layer will spill some of it over the side. This is not a true slopover, but an illustration of one, for to have a real slopover, the oil must have heat wave establishing characteristics.

As an illustration of how a fire could be spread and a slopover might defeat the efforts of extinguishment, in Figure 5 the crude oil tank has been permitted to burn 45 minutes for a heat wave of 11 inches in depth, which in a large container with several feet of outage might not expand the froth over the side when water or foam is applied at a reasonable rate. However, in this small container, when the water content of the foam is expanded into steam, the 12-inch heat wave is sufficient to produce enough froth to spill over the top of the container.

To observe more closely the action of a slopover, in Figure 6 the tank has been burned to an 11-inch heat wave and extinguished with a dry chemical. When foam is applied, the steam bubble formation, sometimes called froth, can be seen expanding the heated layer to a greater capacity than the outage of the tank and spilling over the top.

An oil that has boilover characteristics also has slopover characteristics. Refined oils do not have boilover or slopover characteristics because they do not establish deepening heat waves. Some of them are more viscuous than some crude oils that do have boilover characteristics, but the thin heated layer at the surface is not deep enough to cause either.

For instance, let's take refined Number 6 fuel oil as shown in Figure 7. The tank has burned two hours, yet the heat detecting paint stripe shows that the heated layer at the surface has not penetrated deeper than one and one-half inches below liquid level, so when foam or water is applied to extinguish the fire, it simply cools this thin layer—blankets it—and the fire goes out.

HOW TO DETERMINE HEAT WAVE CHARACTERISTICS

There is a simple way to find out if an oil has heat wave establishing, boilover and slopover characteristics. To determine whether an oil has these characteristics: take a drum with head out, paint a stripe of heat detecting paint from top to bottom, fill it to within 12 inches of capacity and ignite it. Allow the oil to burn for one hour; then put foam on it. If you do not have foam, use water. Repeat these tests until you are sure of the burning characteristics of the oil (Figures 8 and 9).

Also, even considering that the heat wave traveled faster in the small container due to the heat input from the shell, an estimate of the burn-off and heat wave travel placed the crude oil in the average burn-off of low flash point crude oils, and within the average heat wave traveling faster than the burn-off of near the lower limit average of from 12 to 18 inches per hour.

Part 2 Will Appear in the February REFINER

NEW Elliott C-W type N Motor PERMANENTLY SEALED Against Dust, Moisture, Corrosive Fumes

The rugged "Sealedpower" cast frame Elliott motor shown above is the modern version of the design pioneered in this country by Crocker-Wheeler. An external fan, made of sparkless material, and surrounded by a cowl, blows air along the frame for highest cooling efficiency. An internal fan provides continuous air circulation within the enclosure. All openings in the frame are tightly sealed, providing complete protection to windings and working parts.

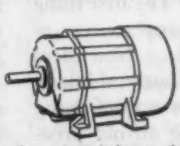
Once applied only in locations where extremely destructive atmospheric conditions prevail, totally-enclosed motors are today rapidly gaining acceptance for all types of applications. Users find that the total over-all cost—first cost plus maintenance—is less than that of open or semi-enclosed motors.

Ask your Elliott representative for details, or write for the new type N motor bulletin. Address Elliott Company, Crocker-Wheeler Division, Jeannette, Pennsylvania.

OTHER C-W TYPE N MOTOR ENCLOSURES

Totally-enclosed non-ventilated

Dripproof Protected



Totally-enclosed, fan-cooled Frames 256 U and smaller

ELLIOTT Company
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We will be glad to send a copy of this new booklet describing the complete line of Elliott C-W type N motors. Please write on company letterhead.

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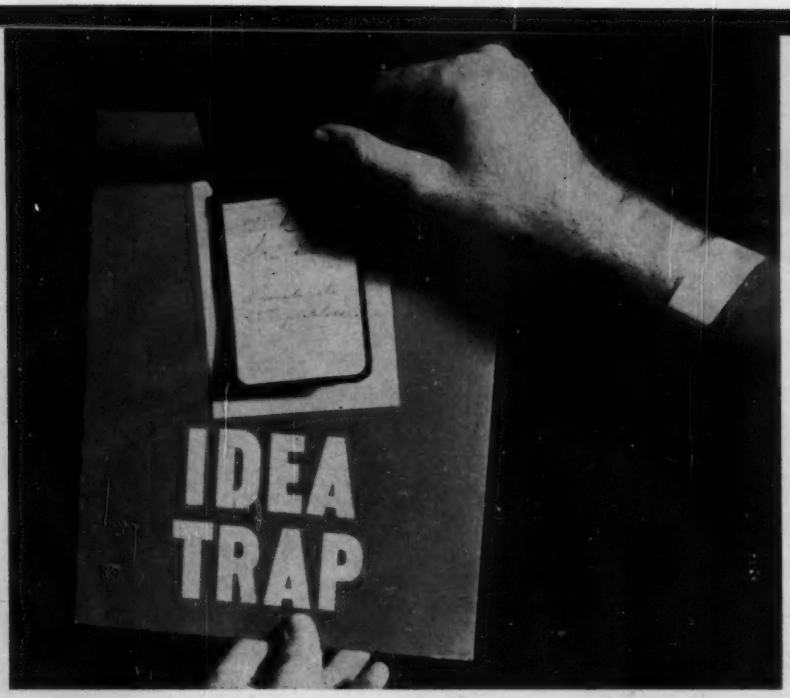


If you get a good idea, "trap it." Keep an "Idea Trap" handy. Jot down your ideas and bring them up at the next meeting. This is an important part of "Creative Thinking."

Make Your Ideas Pay!

Here are five ways to do it:

- **Use every idea at your disposal**
- **Sift out the good ideas**
- **Re-define the problem**
- **'Sell' your ideas**
- **Brainstorming**

Charles H. Clark
Ethyl Corporation
New York City

ANY WAY YOU look at it, individually or in groups, creative thinking is a one way thicket to dollar profits.

And regardless of what anyone says, you don't have to be an Einstein to think creatively. You just need to know a few simple psychological laws. True, you may not come up with a new way of looking at the universe, but chances are excellent that you will produce some new ideas that will help your company, and enhance your own value as an employe.

Chances are also very good that you will not reach your full potential. Human beings have a tendency to reach a certain point of attainment, and then settle back rather comfortably into what is frequently described as a rut. When a great many individuals in an organization do this, the result can spell disaster for the company.

Many companies have recognized the importance of this problem. Ethyl Corporation for one, has sponsored a course in creative thinking and has obtained excellent results. Basically, the task of thinking creatively can be broken down into four general categories, which can be learned and understood by anyone with normal intelligence.

1. Use Idea Sources. The first thing to do is to use the many sources of ideas available to all of us. New ideas can come from consciously thinking or searching for a better way of doing something or improving an old process. New ideas can also come from the "subconscious mind." That is, after consciously thinking about a subject, just as consciously forget about it, and let the subsoil of the mind work on it.

Many is the discovery or new development that has occurred to man while he was doing something in no way related to the subject. A common example of the subconscious at work is the case of a forgotten name. Many of us have tried to recall a name and been unable to, only to have it pop up into the mind long after we have given up consciously searching for it. This is the "subconscious" mind at work. It never sleeps and it never forgets, psychologists tell us, but it works best when left alone.

Other sources of ideas are conversation with others, or reading, movies, television. Keep an idea bank, creative thinkers say. You may not need the idea immediately, but it will be nice to have some ideas in your account when you want to draw on it. An idea bank can be as simple as a little black notebook and the jotting down of a few key words that will stimulate your thinking. More elaborate idea banks can be a compilation of clippings from newspapers or references to books and articles.

2. Separate "Wheat from Chaff." After you have an idea, or a great many ideas, what should you do with them? Suppose your problem is a lack of money to accomplish what you have set out to do. After you have thought about it consciously and unconsciously, tapped your idea bank, and have made a list of the possible solutions, the next step is to sift and evaluate your ideas. Here is where your critical judgment plays its part. Each idea should be carefully examined, the benefits weighed against the disadvantages, until from the entire list you have decided upon the best possible way.

3. Redefine the Problems. Sometimes however, after you have completed step two, you still have no adequate solution to your problem. In this case, the next thing to do is to redefine your problem. Perhaps you have expressed it in such a manner that a practical solution is impossible and formed a mental block. The great American philosopher John Dewey said: "A problem well stated is half solved."

There are many ways to redefine

DU PONT *Petroleum Chemicals* NEWS

One of a Series of Bulletins for the Petroleum Industry

JANUARY 1957

New Du Pont presentation will inform public on oil industry

DU PONT VICE-PRESIDENT

JOHN F. DALEY, a director of the American Petroleum Institute and a member of the Institute's General Committee, Division of Refining, was recently appointed a vice-president of the Du Pont Company.

Mr. Daley joined the Du Pont Company in 1915 as a timekeeper in the explosives plant at Carney's Point.

When made a vice-president he also became a member of the executive committee and director of Du Pont. Prior to holding these positions, Mr. Daley was general manager of the Organic Chemicals Department, which includes the Petroleum Chemicals Division.

In 1940, Mr. Daley's experience in explosives manufacture was made available to the government. During the war, he served as manager of the Indiana Ordnance Works and as deputy field director of ammunition plants, with jurisdiction over 55 government-owned plants. For this work, he was awarded a commendation for exceptional civilian service by the Secretary of War.

He returned to Du Pont as director of pigments sales in 1944, later becoming general manager of the Pigments Department. He was appointed general manager of the Organic Chemicals Department in 1948.

A clear, concise—yet highly dramatic—explanation of our American business system is packed in the small, lightweight briefcase pictured below. It's a presentation kit with a story woven closely around oil industry products and activities. Tentatively, it has been named "A 'Brief' Case for Business."

The theme of the story is that the *customer* actually makes the important business decisions today. It also points up very clearly the interdependence of big and little businesses in filling customer needs.

PETROLEUM PLAYS an important part in the production of all the items in this presentation kit. And the entire kit fits compactly into the lightweight easy-to-carry briefcase.

This public relations presentation—prepared by the Du Pont Petroleum Chemicals Division—shows how oil is truly the lifeblood of American industry. Yet its points are made in such a way that they are applicable to almost any segment of our economy. The audience appeal of this presentation is, therefore, exceedingly broad.

"Magic Barrel" idea

The new briefcase kit tells an oil industry public relations story in much the same way as the popular "Magic Barrel" has been doing so successfully for a number of years.

The briefcase is not meant to replace the "Magic Barrel," which will be continued. Rather it is to supplement that program. It can be presented to groups who have already seen the Barrel, or where the Barrel is for some reason not feasible or appropriate. The new presentation has been streamlined, including fewer items than the Barrel. These items, however, have been carefully selected to tell the story forcefully.

Low cost

Another advantage of the briefcase is its low cost . . . only $50 including all the products in it.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

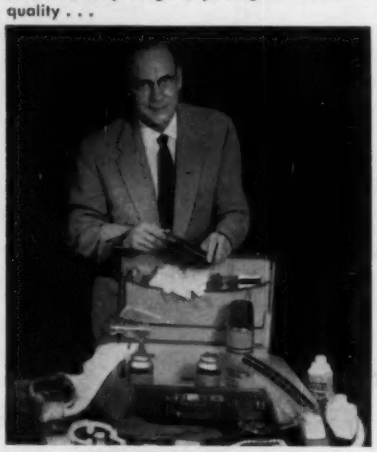
DUPONT *Petroleum Chemicals* NEWS

CONTINUED

New Presentation

Within the oil industry, there are now about 1200 speakers trained to give the "Magic Barrel" presentation. These men and women can, with practically no additional training, present the new program. And to acquaint them quickly with the new kit, we are supplying complete instructions as well as an easy-to-follow script.

THE NEW petrochemicals presentation is easy to learn, easy to give, yet high in dramatic quality . . .



H. C. THOMPSON, assistant promotion manager, demonstrates.

Now available

This new presentation is being sponsored by the Oil Industry Information Committee. To order these kits, or for further information about them, just get in touch with one of our representatives at the nearest Du Pont Petroleum Chemicals Division office listed below.

We will also be glad to train as presentation speakers—at no cost to refiners—any personnel who are not familiar with this type of public relations program.

DuPont Estersil GT solves problem of "leaking greases"

Crane and power shovel operators, among others, are reporting unusually satisfactory results from greases made with Du Pont Estersil GT (grease thickener).

One contracting company, for example, wanted a grease which would not leak on hoist drum brake bands, particularly at high ambient temperatures. A number of different greases were tried with no success in solving the problem.

The contractor's petroleum supplier then suggested an estersil-based grease. This type of grease will not break down even under severe high-temperature, high-shear working conditions.

The experiment was an outstanding success. The estersil grease was used on three different crane hoists. In all cases, the leakage problem was completely solved.

Conversely, estersil greases also have properties that are the answer to many extremely low-temperature lubricating problems. Since wide temperature changes produce little change in their consistency, there is little danger of estersil greases losing their lubricating value in sub-zero temperatures.

High water resistance

In addition to outstanding thermal stability, estersil greases have "built-in" water repellency and superior mechanical and oxidation stability. They also have superior handling qualities and can be easily manufactured.

Du Pont Estersil GT is now available in commercial quantities. Any of our representatives will be glad to give you samples and more complete information. Call the sales office nearest you.

Film dramatizes oil industry expansion

"It Never Rains Oil" is an animated color cartoon about a very serious subject.

It tells how percentage depletion helps to keep oil production ahead of the world's mushrooming demand. You have probably seen the film and of course know the value of percentage depletion.

However, the point of this suggestion is—shouldn't *more* and *still more* people be informed on this important subject?

Movie prints are still available for your use. In case you know of some other groups who should see it . . . new personnel employed over the past two years, for instance . . . write for the film.

Planned and produced by the Du Pont Petroleum Chemicals Division, the film is sponsored and distributed by the American Petroleum Institute, Independent Petroleum Association of America, Mid-Continent Oil and Gas Association, Rocky Mountain Oil and Gas Association and Western Oil and Gas Association.

Big and small businesses work together

The tremendous amount of business generated by "big business" for "small business" is pointed up in a new survey by the Du Pont Company. It shows that small firms represent 90% of Du Pont's 75,000 customers and 30,000 suppliers.

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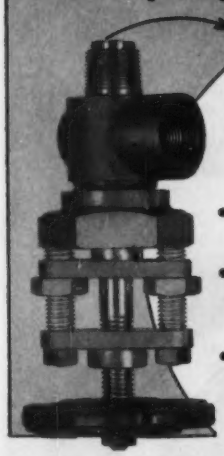
OVER

Serial No. A-3266

Printed in U.S.A.

New!
Jerguson Drain or Sampling Valve



- completely self-draining
- withstands severe conditions
- foolproof operation

¾" size shown

The new Jerguson No. 23 Drain or Sampling Valve is completely self draining, for the valve stem seats on the outside of the valve body. It is ideal for installations where it is desirable to have the valve seat inside the wall of a vessel in order to prevent the typical condition of liquid remaining in the nipple and valve inlet.

This rugged, new Jerguson Valve has outside screw and yoke construction to meet high temperature or corrosive conditions where inside threads cannot be tolerated. The efficient outside thread design eliminates possible freezing and allows the valve stem to work freely at all times. The No. 23 Valve provides foolproof operation because the stem is constructed with a left-hand thread, thus allowing the valve handle to operate in the normal direction of standard valves.

Available in sizes from ¾" to 2" N.P.T. ¾" and 1" sizes are recommended for pressures of 4000 lbs. @ 100° F. and 1000 lbs. @ 750° F.; 1¼, 1½ and 2" sizes are recommended for 600 lbs. @ 100° F. and 250 lbs. @ 750° F. Optional features include construction with additional outlet for such uses as a steaming out connection and with a reamer on the end of the stem to break away encrusted matter which may have collected on the inside vessel wall.

Write for data unit and complete details.

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As Management Sees It . . .

a problem. Perhaps you've stated it too loosely. Try tightening it up, keeping it to specifics. Perhaps you don't have the right key word. Try substituting words. This may give you an entirely new slant. It's also a good time to go over your idea bank. There might be something in it that will give your thinking a new slant or direction.

4. "Sell" the idea. Let's suppose you have come up with a new idea, or a solution to a difficult problem. Where do you go from there? This is the last and toughest step. Unless you act on your ideas, nothing's going to happen.

If you're not the boss already, the chances are you're going to have to put your idea across to the man above you. This may also be a time to reverse your creative thinking, and do a little destructive thinking on your brain child. At this point, actually try to find as many weak spots in it as you possibly can. Look at it as an idea you didn't have anything to do with, and start tearing it apart. You can be certain your boss is going to do just this, and you'll be that much further ahead if you can anticipate him.

Douse your idea with these three negative cold-water attitudes:

- It looks good on paper, but in actual practice it's not true.
- It probably is true, but it's still of no practical value.
- It's a good idea, but somebody else thought of it first, and it didn't work.

If you can get over these three hurdles you're on the home stretch way in front of the pack. Present your idea imaginatively, figure out the benefits, not only for yourself, but for others, and make it easy for the head man to say yes. Remember, he's busy, but he's always looking for a way to improve on things—if it's presented to him in the proper manner.

To be successful at thinking up new ideas by yourself you have to have one other quality—confidence. Don't sell yourself short, and when the ideas start to come, keep them flowing. Don't block your mental processes by not believing in yourself. Always remember, anyone can come up with good, workable ideas, and the man who does is the man who gets ahead.

How to "Brainstorm." Creative thinkers have also spent a good deal

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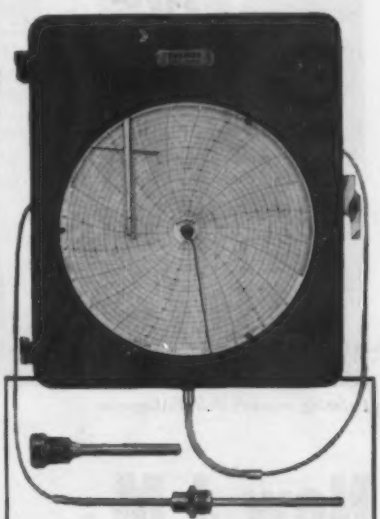
Into this modern Mercury Actuated Recorder has gone all the skill of Palmer master craftsmen.



Readings are clearer, smoother and more precise than ever thought possible. In fact readings are so amazingly improved that maintenance is never needed under normal uses.

Recording Thermometers feature twelve inch die-cast aluminum case with black wrinkle or white satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges —40 to 1000°F. or Equivalent in °C.

Send for Bulletin No. 45

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For more data on advertised products, use Readers' Service Cards, last page.

Painting, courtesy Power Magazine

New J-M Color Code

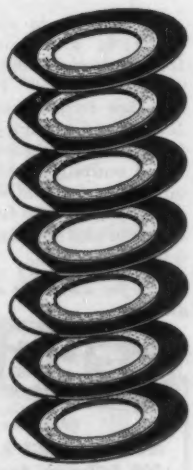
identifies metal in Spirotallic® Gaskets

Most engineers know that Spirotallic Gaskets maintain a perfect seal despite extreme fluctuation in fluid pressure and flange compression. Consequently, these gaskets are used in a wide range of service conditions which include high temperatures, elevated pressures and active corrosives. To withstand these conditions, Spirotallic Gaskets employ a variety of corrosion-resistant alloys.

Because so many of these metals look alike, only expensive tests or costly experience with the gasket could determine the gasket metal used, once its identifying tag was lost. Now the color patch on the centering guide tells the metal employed and saves time, trouble and expense. This new method of identification also makes it easier for storekeepers and mechanics who handle the gasket. In addition, it simplifies inventories.

Spirotallic Gaskets hold their seal because they are made of spirally wound interlocking plies of asbestos and spring-like metal strip. These gaskets compress easily with light bolting. For catalog PK-35A and copy of color code card write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ont.

Here are seven of the metals available and their color identifications



Zinc-coated steel—white

Type 304 Stainless—yellow

Type 316 Stainless—green

Type 347 Stainless—blue

Monel—orange

Copper—brown

Aluminum—aluminum

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville SPIROTALLIC GASKETS

For more data on advertised products, use Readers' Service Cards, last page.

of time working out a method for several people to think at the same time. The name for this group thinking is "brainstorming," and it's a formula that has already produced a legion of labor and money saving ideas.

This teamwork creative thinking is very simple, requires practically no equipment, and there are only a few rules to follow. The first thing needed is a problem, and everyone has plenty of these. Next get a group together with a sufficient understanding of the problem to be able to suggest ideas intelligently. A secretary or a tape recorder to take down ideas is the only other needed equipment.

The chief ingredient of a successful brainstorming session is an unfettered atmosphere, a climate of thinking where anything goes. There should be no do's, don'ts, or can'ts, or any kind of judicial reasoning.

Here are the four rules to be followed in brainstorming:

- Criticism of ideas must be withheld until later.
- "Free wheeling" is welcome! The wilder the ideas the better. It is easier to tame down than to think up.
- Quantity is wanted. The greater the number of ideas, the more likelihood of good ones.

Meet the Author

CHARLES H. CLARK graduated from Harvard University with a B.A. degree in 1943, and from the University of Pennsylvania with an M.S. degree in education, in 1952. Prior to joining Ethyl Corporation's Public Relations department, he was associated with the Philadelphia Electric Company as an office methods analyst. He has spent several years in research on his specialty, a course on "Creative Thinking." He collaborated on the first college textbook and teachers manual on "Applied Imagination."

Put yourself in this picture . . . You're getting "down-to-earth" facts on how you can save money through more efficient sealing methods.

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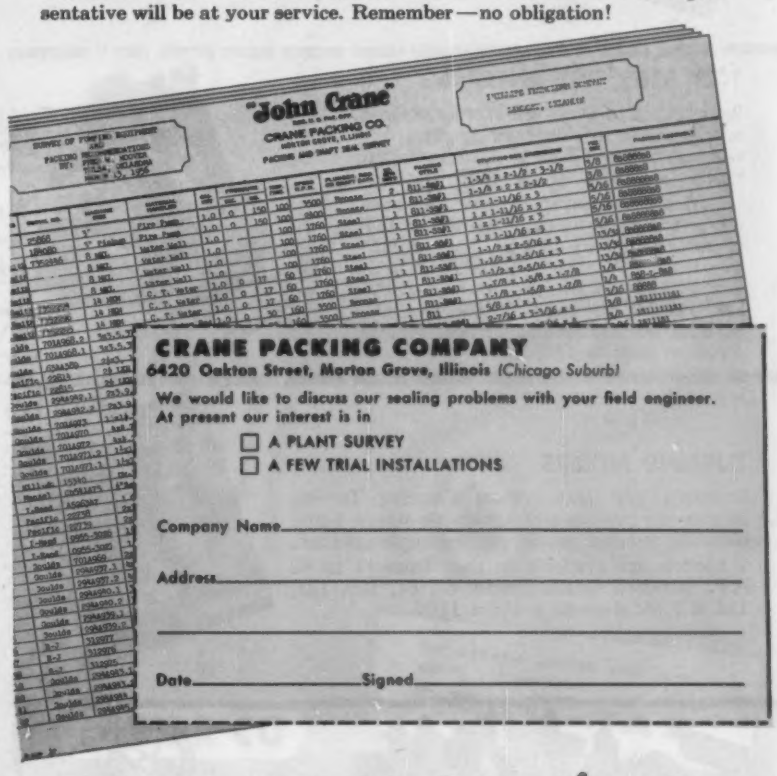

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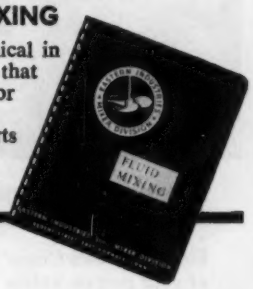

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Series H at 1725 R.P.M., Series S at 1125 R.P.M., and Series G at 420 R.P.M. are available in motor ratings from 1/20 to 5 H.P. Also available are special speeds, variable speeds, as well as air driven models. *Request Bulletin 520.*

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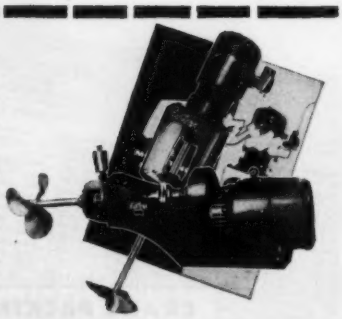
Series C, for average tank capacities, are available in sizes of ¼ to 10 H.P. at these standard speeds: 1725 R.P.M. (up to 5 H.P.); 1140 R.P.M. (up to 10 H.P.); 420 R.P.M. (up to 7-½ H.P.); 280 R.P.M. (up to 5 H.P.). Available in both horizontal and vertical models. *Request bulletin 620.*



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Models are available in sizes from ¼ to 40 H.P. Standard speeds are 56, 68, 84, 100, 125, 155 R.P.M. *Request bulletin 1200.*

EASTERN INDUSTRIES, INC.

DEPT. E - MIXER DIVISION Regent St., Norwalk, Conn.

As Management Sees It . . .

Combination and improvement are sought. In addition to contributing ideas of their own, panel members should suggest how suggestions by others could be turned into better ideas, or how two or more ideas could be combined into a still better idea.

It's also best if possible, to brief panelists a couple of days ahead of time with a one page memo. That gives the "subconscious" time to work on the problem. Let the man who poses the problem answer questions for the first five minutes of the session as a warm up. After that, anything goes.

As the ideas pour out, the secretary or the tape recorder takes them down. Don't worry about judging them until much later. And don't let anyone use "killer phrases" at these sessions, such as "that won't work," it's been tried," or "too expensive." The atmosphere should be anything goes, and it means just that.

One other thing recommended for a good "brainstorming" session is that all of the group be on approximately the same level. A vice president in charge of sales and a foreman won't be able to relax quickly enough in each others presence to assure a warm, creative atmosphere. The best results usually come when a group is limited to from eight to twelve people.

Frequently an off-beat warm up session is used before the real work begins. At one meeting a picture of a mournful dog, was shown and the brainstormers asked for captions for the picture. In four minutes, there were over 90 suggestions. (The winner by applause was "Is *that* the starting salary?"). After that the group went on to turn up 206 ideas in fifteen minutes on a more serious problem.

Brainstorming experts admit that only about six to ten percent of the ideas garnered at a session are workable, but this still adds up to far more than they can count on getting through usual channels. That brainstorming can pay off handsomely was demonstrated last year by the Chicago division of a large corporation. There the plant superintendent and two foremen brainstormed a plan to install a conveyor system, for which $200,000 had been appropriated. They worked out a different system which was installed at a cost of about $4000. ##

For more data on advertised products, use Readers' Service Cards, last page.

DESIGNED AS A TEAM

HI-STRENGTH F-303-S is recommended for catalytic regenerator linings, stack linings, bubble towers and duct linings exposed to abrasion or corrosion.

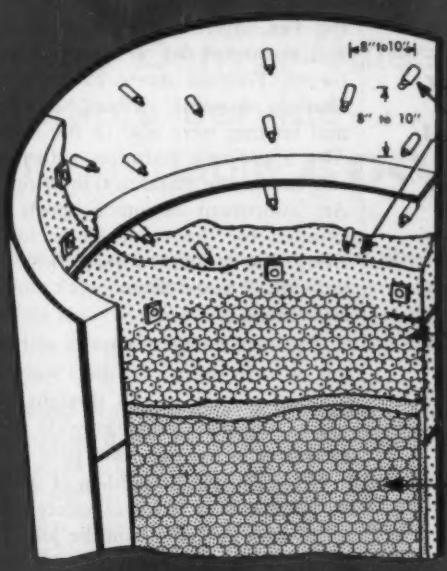
I-R-C 20-G produces a light-weight lining with excellent strength and insulating efficiency. I-R-C 20-G is ideal for lining ducts, clues and breechings.

USE MEX-R-CO COMPANION CASTABLES FOR A COMPLETE REFRACTORY LINING

We make it our business to specialize in Refractory Castables and their application . . . and have the "know-how" gained through years of experience in in-service testing with the close cooperation of a number of Refinery Engineers.

Our products and methods are approved by major Engineering firms and Petro-Chemical companies.

HI-STRENGTH F-303-S and I-R-C 20-G are widely accepted for use in combination to form composite linings in catalytic regenerators, reactors, lines, still and other petroleum equipment.



Step 1
Stud is resistance-welded to steel shell.

Step 2
I-R-C 20-G installed to back of stud-head plate. (10-gauge wire mesh may be used to retain insulating castable during gunning.)

Step 3
Steel mesh welded to stud head plate.

Step 4
HI-STRENGTH F-303-S gunned into hex-mesh.

DUO-COMPONENT LININGS HAVE MANY ADVANTAGES

After the anchor studs are spot welded to the steel shell (as shown at left) I-R-C 20-G is air-placed against the shell and built up to the under-edge of the stud heads. Steel mesh should then be placed on the stud heads and HI-STRENGTH F-303-S applied through the mesh and built up to the surface of the hex-steel. Anchoring and lining methods, as shown, are generally applicable; our Engineering Department will gladly recommend other methods and give more complete details, to suit particular requirements, upon request and at no obligation to you.

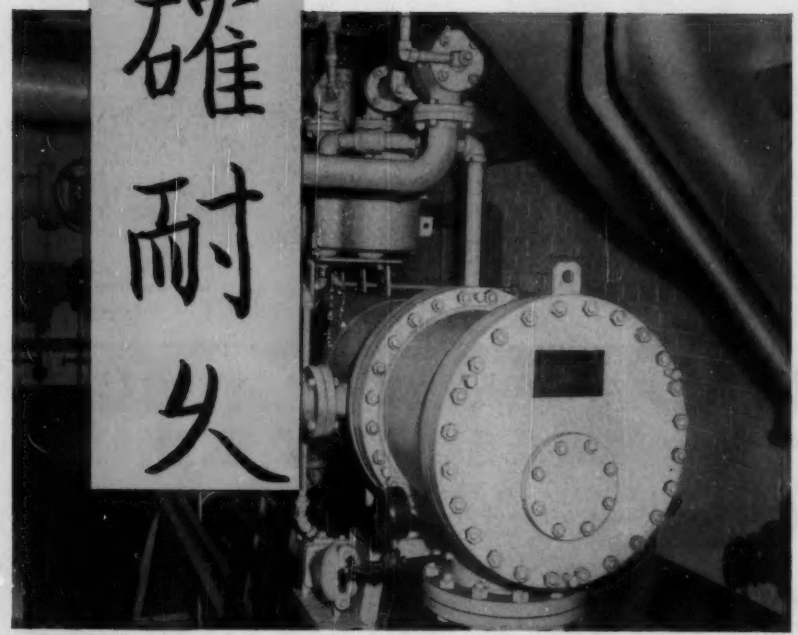
For extreme erosion and high-purity requirements . . . USE
PURO-TAB

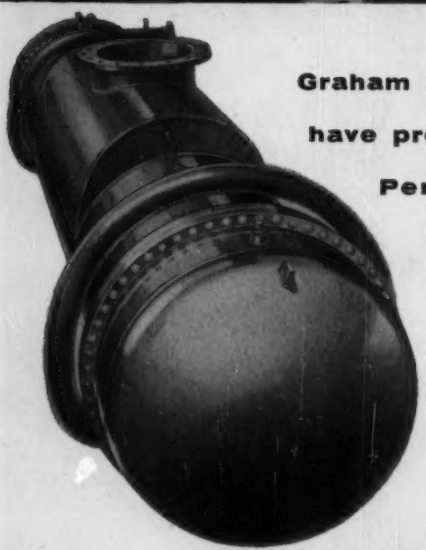
MEX-R-CO

MEXICO REFRACTORIES COMPANY
MEXICO, MISSOURI
NILES FIRE BRICK DIV. — Niles, Ohio • NATIONAL REFRACTORIES DIV. — Philadelphia, Pa. • BIG SAVAGE REFRACTORIES DIV. — Frostburg, Md.
Canadian Affiliate: REFRACTORIES ENGINEERING & SUPPLIES, LTD. — Hamilton, Ontario, Canada

For more data on advertised products, use Readers' Service Cards, last page.

精確耐久





Graham Surface Condensers have proved their "Superior Performance" for well over a quarter of a century with many thousands of enthusiastic users

May we quote on your next job?

Graham

MANUFACTURING CO., INC.

415 LEXINGTON AVE., NEW YORK 17, N. Y.

Offices in all principal cities

As Management Sees It . . .

Watch That Tango, You Could Get Hurt

Fun is not necessarily all fun. The Du Pont Company has discovered that year in and year out nearly twice as many of its employes get hurt in sports as at work. And this being the end of the football season, it has come up with its own Big Ten—the 10 sports which throw the most employes for a loss of a day or more of work by injuries.

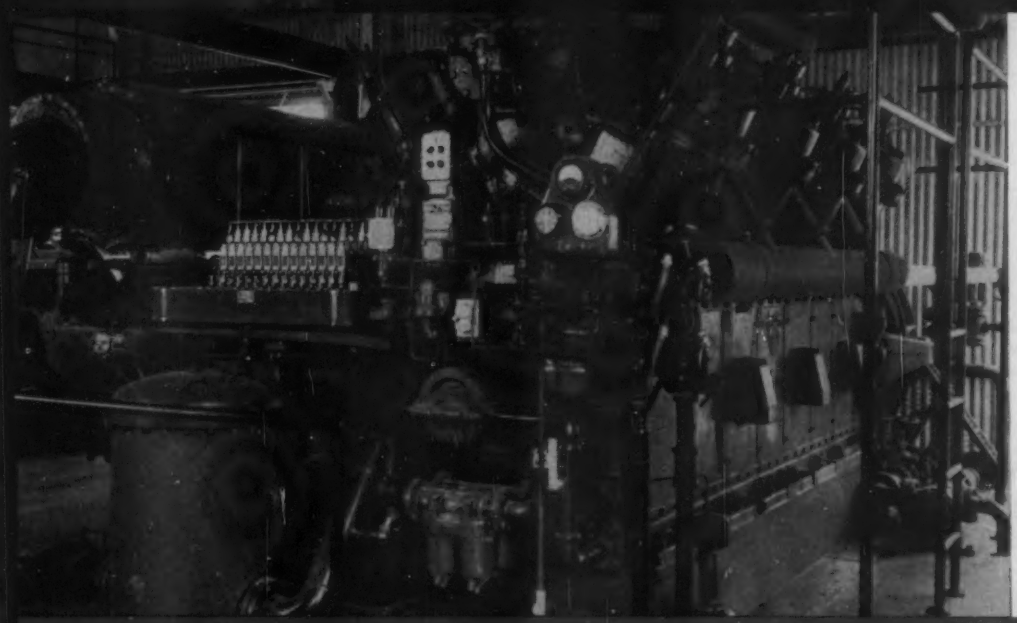
How to cut this Big Ten down is a problem which is engaging the company's safety engineers. Everyone agrees that the injury of an employe is just as serious whether he is hurt in the plant or out dancing, which in itself can be dangerous. Three employes have been seriously injured while dancing in the last three years. Nobody was hurt wrestling.

Counting up lost-time injuries among its 100,000 employes over the last three years, the company discovered 515 were hurt while participating in various sports. Only 265 were injured in all the time they spent at work. Injuries from all causes off the job produced a whopping big figure—4,925.

Baseball carried the top spot in this Big Ten, injuring 202 people. Basketball accounted for 58 and swimming for 43. Football threw 26 for a loss. Skating, hunting, fishing, bowling, and boating were also in the league. The apparently harmless volley ball was last in the standings, injuring 11. An assortment of other sports accounted for the other 83 accidents. Every one of these injuries kept the individual away from work for at least a day.

The ever-dangerous sport of hunting is well down the list, with 21. This gives rise to the thought that maybe the years of nationwide effort for safety in hunting have paid off.

It is primarily a problem of getting all employes to work at safety away from work as they do on the job. The effort takes the form of publicity, safety meetings, movies and the like. Some plants work with local schools, some develop safety check lists for homes and encourage employes to inspect their own homes. They work with local safety councils and other organizations. ##



One of the 8-cylinder GMXA's compressing low pressure gas for the production of propane, butane and gasoline in the Little Beaver "dry" gasoline plant.

Another example of efficient power at lower cost

This modern plant in the Denver-Julesburg Basin contains eight Cooper-Bessemer 500 hp GMX-A's totaling 4,000 reliable compressor horsepower.

In the Denver-Julesburg Basin . . . multiple service . . . . multiple advantages with portable **COOPER-BESSEMERS**

• Offering unmatched economy in all phases of operation . . . Cooper-Bessemer GMXA compressors efficiently handle eight to ten million cubic feet of low pressure gas per day in the Little Beaver "dry" gasoline plant, Morgan County, Colorado.

Operated by Continental Oil, and owned by a number of companies, this plant in the Denver-Julesburg Basin is connected to a system of 169 wells. Six portable GMXA's, rated 500 hp at 400 rpm, handle three stage gas compression from 1 to 865 psig. Two additional Cooper-Bessemers are used for refrigeration and recompression service.

If your future plans include engines or compressors in the 200 to 5000 hp range . . . for the usual, or the very unusual . . . you'll profit from a call to the nearest Cooper-Bessemer office. Cooper-Bessemer equipment has long been recognized for handling *all* types of jobs with minimum difficulty and continuing economy, even after many years of severe service.

ENGINES: GAS • DIESEL • GAS-DIESEL COMPRESSORS: RECIPROCATING AND CENTRIFUGAL, ENGINE OR MOTOR DRIVEN

cooper-bessemer

MOUNT VERNON, OHIO • GROVE CITY, PENNA.

Branches in principal U.S. Cities, also: Edmonton and Calgary, Alberta • Halifax, N.S. • Caracas, Venezuela • Mexico City, Mex.

What's Happening . . .

. . . in the Industry

LP-Gas Sales Soar Past All Records

Increase of more than 1 billion gallons is recorded for the first time in history.

LP-GAS SALES IN 1956 APPEAR TO have increased by a record breaking 1 billion gallons sending sales to an estimated 6.99 billion gallons. This is a 16.7 percent increase over 1955 total sales.

The figures presented in this annual report were compiled by George R. Benz, manager, Engineering department; Paul W. Tucker, technical representative, Engineering department; and W. F. DeVoe, manager of LP-Gas sales, all of Phillips Petroleum Co., Bartlesville, Okla. The following analysis by the authors provides an interesting insight into just why 1956 LPG sales broke all previous records.

Domestic and Motor Fuel—Up 17.8 percent to 4.068 billion gallons. House heating continues as the largest domestic use and motor fuel becomes increasingly important.

Industrial and Miscellaneous—Increased by 10.4 percent to 614 million gallons to outstrip generally strong industrial activity.

Gas Manufacturing—Up by 9.5 percent to 234 million gallons, continuing a trend started in 1955.

Chemical Manufacturing—Advanced 20.1 percent to 1.642 billion gallons in spite of steel strike which retarded chemical plant construction.

Synthetic Rubber—LP-Gas used in the manufacture of synthetic rubber components increased by 8.1 percent to 439 million gallons after a tremendous gain in 1955.

Increases are impressive in chemical, motor fuel and house heating. New applications continue with production, storage and transportation facilities keeping pace with rising demand. Another record year is seen in 1957.

Domestic and Motor Fuel—Combined domestic and motor fuel market for LPG in 1956 increased by 17.8 percent over 1955. House heating, still the largest factor in domestic growth, continues to move north as more people become familiar with and are sold on the convenience of gas. The expansion and extension of natural gas lines cause more people to become "gas conscious."

The use of LP-Gas for crop dehydration and similar uses continued to grow in spite of the drought in the Southwest. This is a growing market for LP-Gas and will probably continue even when the drought breaks.

Motor Fuel—Almost 850 million gallons of LPG were used in internal combustion engines in 1956. This is a 30 percent increase over 1955 and represents approximately 12 percent of total industry sales. Biggest users were trucks, buses, tractors, industrial trucks, irrigation and drilling engines.

Lift trucks and cargo refrigeration units still represent the fastest growing motor fuel market, while truck conversion continues to increase but at a slower pace. More LP-Gas service stations are becoming available to take care of this market.

The industry is still in need of truck engines properly designed to utilize LP-Gas. Only one manufacturer has built truck engines specifically for LP-Gas, and performance of these has been almost spectacular. Others are still using modified gasoline engines.

Industrial and Miscellaneous—Part of this 10.4 percent increase in this category is due to the inclusion of refinery fuel gases containing LP-Gas. The continued increase in business activity plus new uses, increased demand for LPG as an industrial fuel. The addition of standby plants continues as protection against winter shut-downs. The demand for this portion of the industrial load is determined by the severity of the weather. Asphalt aggregate drying is a relatively new industrial application and should expand rapidly with the Fed-

TV Checks Safety at Bayway

Television is now being used for the first time by Esso Research and Engineering Co. in pilot plant operations at Bayway, N. J. The closed circuit permits shift foremen to check safety of operators in a pilot plant 300 feet away. Should trouble develop or operator fall ill, foremen would know instantly and could take emergency measures. Another receiver is installed in shift inspectors office.

When you need...

Whatever the GRADE and the VOLUME of

NATURAL GASOLINE

Just rely on WARREN'S versatile facilities to give you dependable deliveries . . . WHERE and WHEN and the WAY *you* want them.

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PETROLEUM CORPORATION

TULSA, OKLAHOMA • Cable Addresses: STAVOLENE, WARREN

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS, SAN PEDRO, CALIF.

What's Happening . . .

eral highway construction program.

Gas Manufacturing—The utility use of LP-Gas climbed with an estimated 9.5 percent increase over 1955. One new refrigerated storage installation for utility use was completed and interest is being shown in underground storage by utilities for peak shaving. Also, reforming LP-Gas for utility gas purposes is gaining popularity. Again, cold weather is the primary determining use factor. The joint gas promotion (gas utility, and LP-Gas companies) advanced with the formation of the Gas Unity Committee.

Chemical Manufacture—Although the steel strike delayed petrochemical plant construction LP-Gas sales as a raw material for the manufacture of chemicals and chemical intermediates continued to gain rapidly. The estimated 20.1 percent increase was sparked by the growing demand for polyethylene, and the numerous polyethylene plants now under construction assure another gain for 1957. Also, interest in other polyolefins (polypropylene, polybutylenes and polybutadiene) is high.

Despite the drop in automobile production, demand for synthetic rubber expanded, and new butadiene and styrene plants are being built and existing units expanded. Since butadiene is a promising chemical intermediate it is expected that much will be used in other than the manufacture of synthetic rubber.

Large volumes of LP-Gas were used to produce phenols, acetones, glycols, amines, detergents, additives, alcohols and many other oxygenated hydrocarbons. The production of nitroparaffins and their derivatives continued to increase.

This category now includes gas and liquid streams containing methane and ethane plus LPG. These streams have not been considered in the past and would not meet specifications for the "domestic" market. Use of these streams as petrochemical plant feed stocks increased rapidly during the year.

Rubber Components—The use of LP-Gas in the manufacture of synthetic rubber components climbed an estimated 8.1 percent. This is impressive after last year's 32 percent increase. Although some synthetic rubber was stockpiled in 1956, next year should continue strong.

Supply—Twenty-six new plants came on stream in 1956 to boost LP-Gas production by almost 1.12 million gallons per day. These additions plus increased production at existing plants, and the volume in underground storage, enabled industry to meet the record demand. An estimated 15 new plants will be added in 1957 to further increase production by almost 750,000 gallons per day. Also, several plants are adding facilities which will increase production potential. Approximately 75 percent of LP-Gas now comes from natural gasoline plants. More than 50 percent of the liquid produced at natural gasoline plants in 1956 was LP-Gases, with many of the newer plants reaching a ratio of 60 percent or better. With additional investments and higher operating costs, more LP-Gas can be recovered but this is economically feasible only with a better and more stable price situation.

There have been continued increases in LP-Gas storage facilities, both conventional aboveground steel storage tanks and underground storage installations. The estimated available underground storage capacity totals almost a billion gallons and there are about 333 million gallons planned or under construction. Recent information indicates this underground capacity was substantially full on Dec. 1.

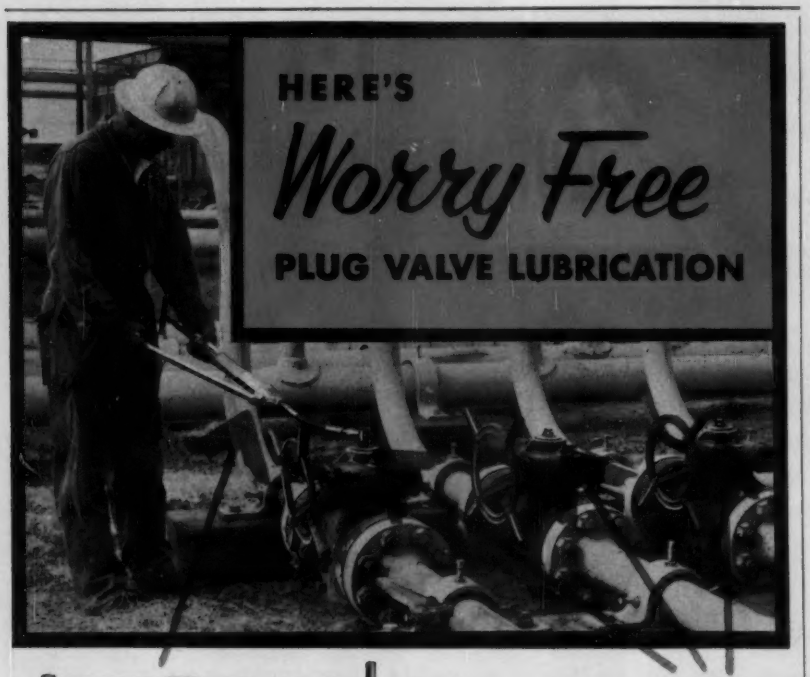
Transportation—Transportation facilities kept pace with increased production and demand as four new pipe lines were either announced or under construction. One new LP-Gas tanker was placed in service, and an estimated 22,000 tank cars were in LP-Gas service at the peak season.

Industry started action for approval of an uninsulated tank car for the transportation of LP-Gas, and considerable interest is being expressed in water transportation of refrigerated LP-Gas.

As a part of the effort to improve its safety record, numerous changes were again made in NFPA Pamphlet No. 58 to keep pace with new developments in equipment and recommended safe practice. Also, a new API standard for LP-Gas storage installations in refineries, natural gasoline plants and marine and pipe line terminals is nearing completion.

Outlook—The 1956 sales broke all records. The increase alone almost equals total sales for 1944 and the total exceeds all that sold during the first 25 years of the industry. Competition for the consumers' energy requirements continues very keen but the LP-Gas industry must be ever alert if it is to continue such record breaking progress.

The market is far from saturated.



DELTA HIGH PRESSURE GUN

This is no ordinary gun. It incorporates many important advantages and safety factors. Handles heaviest lubricants. Develops 10,000 lb. pressure. Positive mechanical spring primer. 30,000 lb. test barrel is cold rolled seamless steel tubing with heavy end sections and safe coarse threads. Hose tested to 20,000 lbs. Fast snap-on coupler enables operator to lubricate 10 to 15 valves *better, faster* and *safer* than he can one valve by conventional methods.

DELTA "GIANT" API BUTTON HEAD FITTINGS

These are the only guaranteed button head fittings on the market. Unconditionally guaranteed not to leak at 15,000 lbs. pressure. Why can we do this? Because they have a one-piece steel body. Precision parts. Double check valves; metal-to-metal seats. There are sizes and types for any plug valve in any service. Holds valve pressure, retains lubricant, protects personnel. Insist on them.

DELTA-DESCO

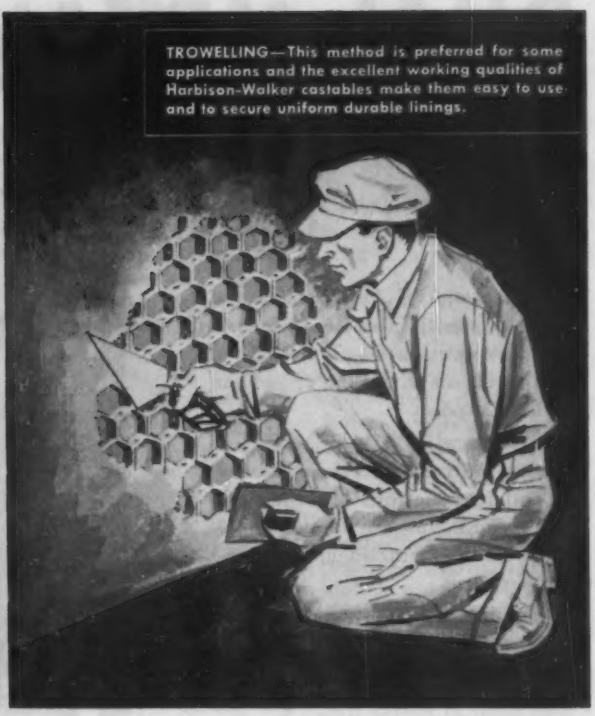
WRITE FOR CATALOG
The Only Complete Plug Valve Lubrication Company

PLUG VALVE LUBRICANTS AND EQUIPMENT

Color Coded Lubricants • Hand Guns
Fittings • Air-Motor Volume Guns
Automatic Lubricators • Electronics

DELTA-DESCO COMPANIES
DELTA ENGINEERING SALES CO.
Box 1403 Shreveport, Louisiana
Branch Offices in All Principal Cities

GUN APPLICATION—For many installations, Harbison-Walker castables are used to best advantage with various types of air placement guns.



TROWELLING—This method is preferred for some applications and the excellent working qualities of Harbison-Walker castables make them easy to use and to secure uniform durable linings.

For refractory linings that last longer...
specify HARBISON-WALKER

H-W EXTRA STRENGTH CASTABLE

H-W 56 LIGHTWEIGHT CASTABLE

Used together as illustrated, these two Harbison-Walker castable refractories form a lining that withstands the erosion, temperatures and pressures of refinery units, and provides highly effective insulation that reduces heat losses. Both products are particularly suited for service in catalytic cracking regenerators, reactors, catalyst feed lines and other units. They can be trowelled, poured like concrete, tamped or applied with air guns.

Write for complete information about these refinery-proved Harbison-Walker castable refractories.

Cross-sectional view shows H-W 56 Lightweight (insulating) Castable next to the regenerator shell, with H-W Extra Strength Castable superimposed for the working lining, where its high strength, excellent erosion resistance and low coefficient of expansion all contribute to long service life.

Harbison-Walker Refractories Company
AND SUBSIDIARIES
World's Most Complete Refractories Service
GENERAL OFFICES: PITTSBURGH 22, PENNSYLVANIA

For more data on advertised products, use Readers' Service Cards, last page.

DUAL METAL... answer to

What is it ?

To thirty-one of America's largest industries with problems of abrasion or corrosion — or both —"Dual Metal" means U. S. Pipe's Steel and Tubes Division.

Specifically, "Dual Metal" is our name for centrifugally cast cylindrical sections in which two dissimilar metals are bonded metallurgically by centrifugal force and temperature.

"Dual Metal" centrifugally cast, integrally fused combinations of two dissimilar metals are doing industry's most difficult and exacting jobs better and more economically than ever before.

Design engineers have been quick to recognize the outstanding merits of a process capable of combining the desired mechanical and chemical properties no single metal possesses.

"Dual Metal" means versatility, efficiency and economy.

Research and development play a vital and important role in the centrifugal casting of "Dual Metal" combinations. Our Pilot Foundry is devoted entirely to process and product improvement.

UNITED STATES PIPE & FOUNDRY CO.

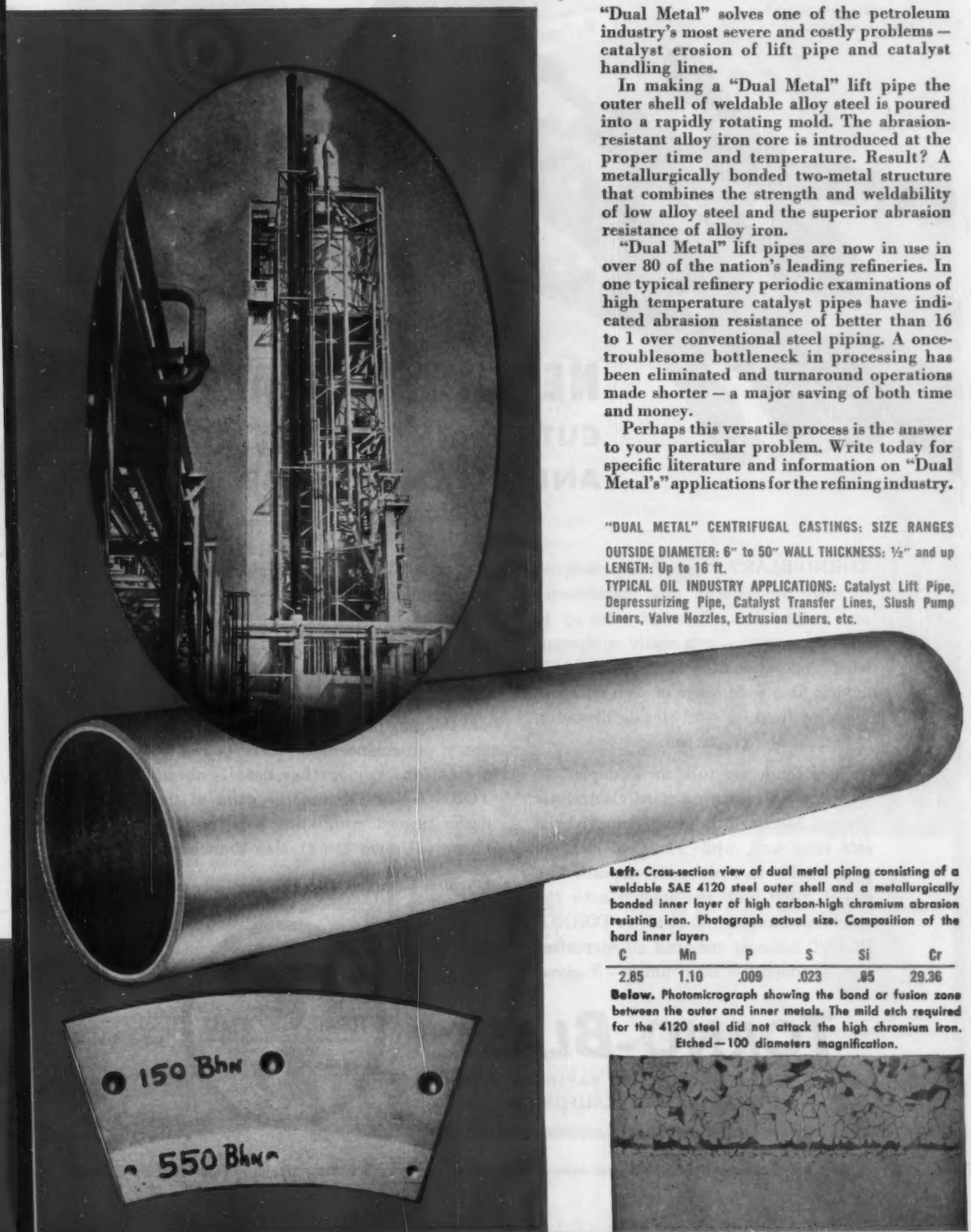
Steel and Tubes Division

STEEL & TUBES U.S. PIPE DIVISION

BURLINGTON, NEW JERSEY

SALES OFFICES: LOS ANGELES, SAN FRANCISCO, CHICAGO, ST. LOUIS, COLUMBUS, DETROIT, PITTSBURGH, HARTFORD, BURLINGTON

your TURNAROUND problems



"Dual Metal" solves one of the petroleum industry's most severe and costly problems — catalyst erosion of lift pipe and catalyst handling lines.

In making a "Dual Metal" lift pipe the outer shell of weldable alloy steel is poured into a rapidly rotating mold. The abrasion-resistant alloy iron core is introduced at the proper time and temperature. Result? A metallurgically bonded two-metal structure that combines the strength and weldability of low alloy steel and the superior abrasion resistance of alloy iron.

"Dual Metal" lift pipes are now in use in over 80 of the nation's leading refineries. In one typical refinery periodic examinations of high temperature catalyst pipes have indicated abrasion resistance of better than 16 to 1 over conventional steel piping. A once-troublesome bottleneck in processing has been eliminated and turnaround operations made shorter — a major saving of both time and money.

Perhaps this versatile process is the answer to your particular problem. Write today for specific literature and information on "Dual Metal's" applications for the refining industry.

"DUAL METAL" CENTRIFUGAL CASTINGS: SIZE RANGES

OUTSIDE DIAMETER: 6" to 50" WALL THICKNESS: ½" and up
LENGTH: Up to 16 ft.
TYPICAL OIL INDUSTRY APPLICATIONS: Catalyst Lift Pipe, Depressurizing Pipe, Catalyst Transfer Lines, Slush Pump Liners, Valve Nozzles, Extrusion Liners, etc.

Left. Cross-section view of dual metal piping consisting of a weldable SAE 4120 steel outer shell and a metallurgically bonded inner layer of high carbon-high chromium abrasion resisting iron. Photograph actual size. Composition of the hard inner layer:

C	Mn	P	S	Si	Cr
2.85	1.10	.009	.023	.85	29.36

Below. Photomicrograph showing the bond or fusion zone between the outer and inner metals. The mild etch required for the 4120 steel did not attack the high chromium iron. Etched — 100 diameters magnification.

TORNO-BLAST #100 sandblast tool designed to fit 4"—12" i.d. pipe and tubing. Easily adjusted roller guides prevent cocking or misalignment, insure fast, complete cleaning.

NEW TYPE BLASTER

CUTS MAINTENANCE COSTS AND CLEANING TIME

TORNO-BLAST is specifically designed to solve problems of pipe maintenance and reclamation. Cleans at rates up to one foot/second – gets costly equipment back in operation faster. TORNO-BLAST models fit a wide range of pipe and tubing sizes from ½"– 12" inside diameter, in lengths up to forty feet.

Take condenser tube for example.* 1" i.d. brass tubes with a hard electrolytic deposit. Mechanical devices damaged the soft tube wall, while chemical cleaners were unable to remove the deposit. The model #300 tool was applied *with the condenser bundles still in place.* TORNO-BLAST not only removed all encrustration, producing a satin finish – it saved the time usually required to dismantle the bundles for cleaning.

Just one of the ways that TORNO-BLAST will help you cut costs in every phase of pipe and tube cleaning, from maintenance to salvage. If there is a special cleaning problem at your plant or refinery, our engineers will assist you at no obligation. For further details about TORNO-BLAST, and the name of the dealer nearest you, write, wire, or telephone (JUniper 4-8121, San Francisco).

**Problem submitted to us by a large oil producer.*

TORNO-BLAST

J. C. FENNELLY CO. 1485 BAYSHORE BLVD.
SAN FRANCISCO, CALIFORNIA

What's Happening. . .

"Weather" conditioning, motor fuel, and other new applications offer excellent opportunities. The Federal highway program offers many opportunities for new and expanded motor fuel applications and chemical use should continue its amazing growth of the past few years.

The industry should experience another excellent growth year in 1957.

FTC Frowns at Gulf Merger

The Federal Trade Commission has charged Gulf Oil Corp. with violating the anti-merger section of the anti-trust law by acquiring Warren Petroleum Corp. Merger of the two companies took place last March through an exchange of $138 million in Gulf common stock for Warren's outstanding common shares.

In a complaint issued in Washington, the F.T.C. charged that the merger either threatens to reduce competition or tends to create a monopoly, particularly in the sale of LPG and natural gasoline. Commission contention is the merger may give Gulf "a decisive competitive advantage over smaller oil companies."

Gulf president, W. K. Whiteford, replied from Pittsburgh that while both Gulf and Warren are members of the petroleum industry, they are engaged in different types of businesses and have never been competitors. Major difference of opinion seems to be whether or not the Warren acquisition increased Gulf's relative size in the industry. Gulf says no, while F.T.C. contends the purchase raised Gulf from twelfth to fourth largest among the U. S. producers of natural gasoline.

Before the merger, the Commission declared, Warren held a dominant position in the production of natural gasoline and LPG, and was a primary source of supply for independent refiners, dealers and distributors. Now, however, these independents may be forced to look elsewhere for their supplies.

Col-Tex Puts Tollett at Helm

Col-Tex Refining Co., subsidiary of Cosden Petroleum Corp., has been completely reorganized, and R. L. Tollett, Cosden president, has been elected president of Col-Tex.

Col-Tex was recently acquired by Cosden (PETROLEUM REFINER, October, p. 254) from Standard Oil Co. of Texas, and Anderson-Prichard Oil Corp., Oklahoma City.

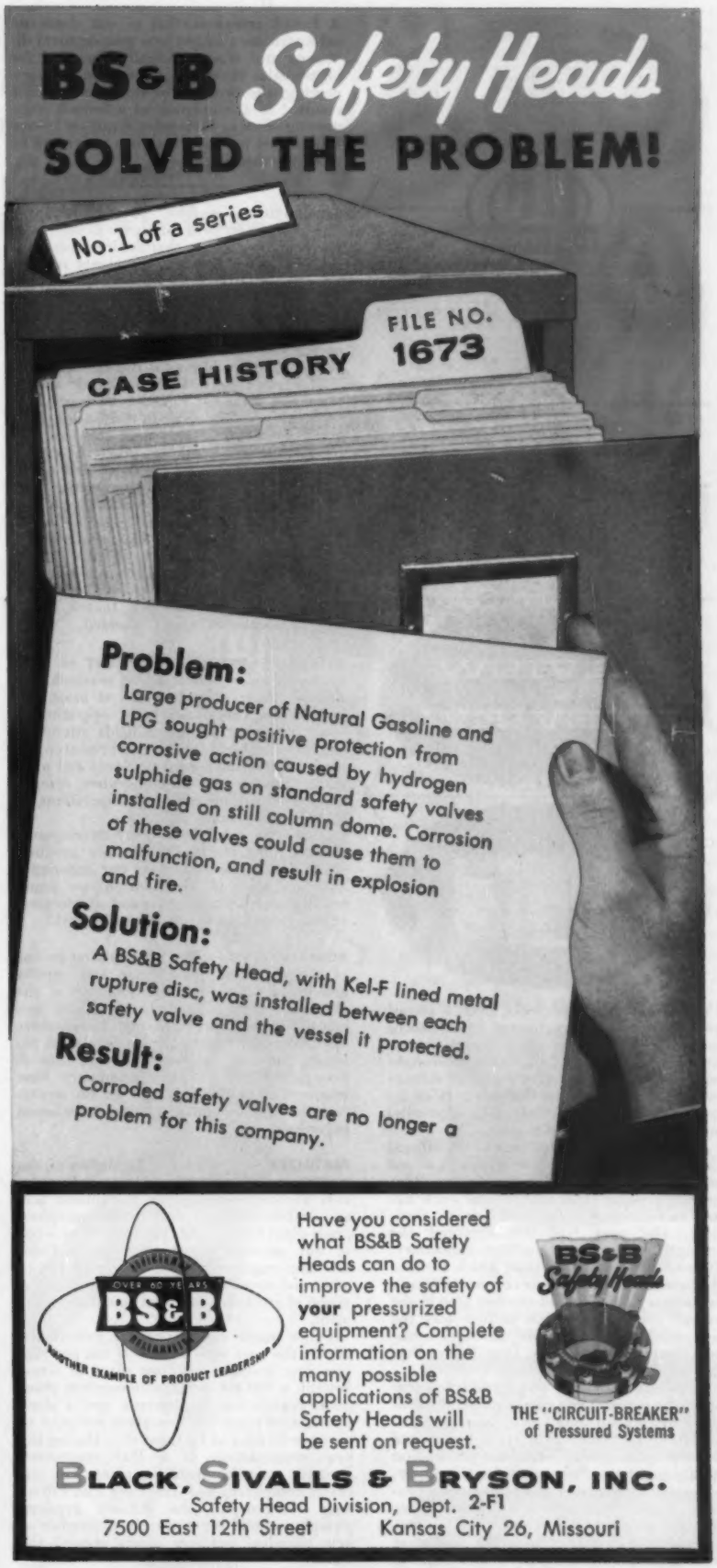
In addition to Tollett being elected president, other new officers included Marvin W. Miller, Cosden executive vice president elected vice president. R. W. Thompson, Dan M. Krausse, R. M. Johnson, and R. O. Wilson were also elected vice presidents. A. V. Karcher was elected secretary, and V. A. Whittington, assistant treasurer.

The new board of directors consists of Tollett, chairman, and Miller, Thompson, Krausse, Johnson, and Wilson.

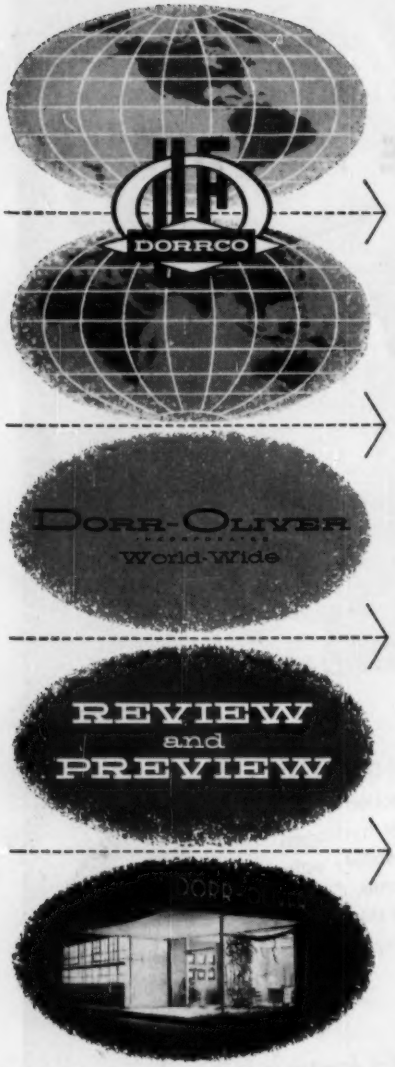
The Col-Tex general offices will be moved from Oklahoma City to Big Spring, Texas.

Role Seen for Independents

Top government officials have given assurance that "independent" segments of the U. S. oil industry will gain representation in emergency oil plans. There does appear, however, to be some disagreement over exactly how these "independents"


BS&B Safety Heads
SOLVED THE PROBLEM!
No. 1 of a series
CASE HISTORY
FILE NO. 1673
Problem:
Large producer of Natural Gasoline and LPG sought positive protection from corrosive action caused by hydrogen sulphide gas on standard safety valves installed on still column dome. Corrosion of these valves could cause them to malfunction, and result in explosion and fire.
Solution:
A BS&B Safety Head, with Kel-F lined metal rupture disc, was installed between each safety valve and the vessel it protected.
Result:
Corroded safety valves are no longer a problem for this company.
BS&B
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP
Have you considered what BS&B Safety Heads can do to improve the safety of your pressurized equipment? Complete information on the many possible applications of BS&B Safety Heads will be sent on request.
BS&B Safety Heads
THE "CIRCUIT-BREAKER" of Pressured Systems
BLACK, SIVALLS & BRYSON, INC.
Safety Head Division, Dept. 2-F1
7500 East 12th Street Kansas City 26, Missouri

For more data on advertised products, use Readers' Service Cards, last page.



1956 has, in many respects, been a record year for us . . . characterized by advances in technology and an all-time high in volume of new orders and also billings throughout the world. This meant a year of strenuous adjustment due to the necessity of increasing our productive capacity to parallel our growing volume of business.

The acquisition of the Merco Centrifugal Co. of San Francisco on February 1, added centrifugals to our product line. This natural outgrowth of our cyclone work has proven to be a most successful move. Similarly, the year has demonstrated the strength of our new Canadian subsidiary, Dorr-Oliver-Long of Orillia, which became the newest member of our corporate family on January 1, 1956. Yet another step in the overall corporate growth picture was the completion of plans to add the ninth member of our overseas family, Dorr-Oliver Pty. Ltd. of Australia on January 1 of 1957.

Steps in matching our productive capacity to our growing needs included a million dollar expansion of our Hazleton plant scheduled for completion at the year's end and the opening of a sizable new production facility nearby in Pennsylvania. Currently, a long term expansion and reallocation program is underway which will step-up our ability to produce, and to serve, still further.

Growth and change in other operating areas of the parent company also kept pace.

A broad reorganization of our domestic sales structure added new geographical divisions and was principally designed for better sales coverage and service. In engineering, the pressure of increased volume resulted in the opening of a branch engineering office in Pennsylvania, close by our East Coast plants, which has proven to be most worthwhile.

SANITATION — The new Spirovortex-Superate Filter will produce a degree of purity comparable to that attained using the activated sludge process in plants treating up to one MGD of domestic sewage. We have developed the Degritting Clarifier and Clarigester for low cost grit removal in small plants and during the year we have incorporated important new features into the design of our Vacuum Filters for the sanitary field.

The completely D-O equipped sewage treatment plant for Karachi, Pakistan, represents the largest order in the sanitary field ever entered by our associates in The Netherlands. Typical of other new D-O equipped installations are those under construction in such diverse locations as Charlottesville, Virginia; Caldwell, Idaho; Midwest City, Oklahoma; Delhi, India; Nairobi, Kenya; and Rio de Janeiro, Brazil. Expansion of Providence, Rhode Island, treatment facilities calls for installation of nine Dorr Clarifiers, all over 100 feet square, and at Louisville, Kentucky, four 275 foot long Monorake units will be added.

RESEARCH AND DEVELOPMENT — As a matter of policy, fundamental research continues on our expanding line of basic unit operations. The principle of operating in many different but allied fields stimulates situations wherein fundamental research can produce new and useful products and processes. Such is not possible when interest is confined to but a few basic operations, as in our early years.

Similarly, general company development is continuing the search for new products allied in some manner with our experience and facilities. In this search we count heavily on the assistance and cooperation of our Associates throughout the world.

POLYETHYLENE — Our contribution to one of today's most spectacular and rapidly growing fields — polyethylene — is the Merco Pressure Centrifuge, developed specifically for high pressure, high temperature operation. The basic unit was developed, designed and manufactured in record time to keep pace with the expanding industry. First commercial Centrifuges will go on stream early in 1957 separating catalyst from liquid polyethylene.

FERTILIZER — One of the highlights of the past year was the largest single D-O order ever received involving a phosphoric acid and 200,000 ton per year triple superphosphate plant for a Florida producer. The scope of our services on this project includes architect-engineer design, supply of equipment and construction materials, and supervision of erection and initial operation of the plant.

Other major design projects undertaken during the year were a 350,000 ton per year complete granular fertilizer plant in Great Britain, a 350 ton per day ammonium phosphate installation in Montana, and a phosphoric acid plant for Venezuela designed to produce 50 tons of P_2O_5 per day. During the year construction of a D-O engineered Scottish granular fertilizer plant was virtually completed, and Traveling Pan Filters were ordered for the difficult gypsum-phosphoric acid separation in a number of new chemical fertilizer plants around the world.

(Advertisement)

PETROLEUM — The Hi-Rate Pressure Filter has proven successful as a high-capacity water filter in oil field secondary recovery operations with rates higher than those of conventional units. Initial test work in other fields indicates the versatility and possibility of unusually widespread application of this new filter.

A variation of the D-Sander, first introduced in 1955, has been developed for removal of fine silica from rotary drilling fluids. The petroleum industry purchased during the year over one hundred D-Sanders of both basic types.

METALLURGICAL — Recently placed on the market, the DSM Screen is an ingenious, high capacity screen capable of separations as fine as 200 mesh. Adapted from the Dutch design, the unit has operated very successfully on coal and will handle a wide variety of non-fibrous feed slurries. Other highlights of the year include a number of Thickener-Filter combinations and Bowl Desiltors installed in Eastern coal fields, a D-O equipped iron ore washing plant in California, and a variety of cement plant expansion equipment orders.

FLUOSOLIDS SYSTEMS — A large steel producer in the United States finalized plans for a new fine coal washing plant using a two Reactor FluoSolids Coal Drying System designed to handle 600 tons of metallurgical coal per hour. In the non-metallics field, three fluidized Reactors went into operation — two in the Detroit area drying blast furnace slag used in cement manufacture, and the other calcining clay in Scotland. Systems are now under construction to dry and pre-heat oyster shells and to calcine Massachusetts limestone.

Four new installations in Japan will roast 265 tons of zinc concentrates daily, producing both a readily usable calcine and SO_2 bearing gases for contact sulfuric acid manufacture. During the year two installations in the U. S. and South Africa operated successfully roasting copper for direct electrowinning. And pyrite roasters were ordered for a Canadian uranium mill, Chilean and Nicaraguan copper concentrators, French and Philippine fertilizer plants, and two Scandinavian pulp mills. In all, 21 fluidized Reactors were sold in 1956.

INDUSTRIAL WASTES — D-O equipped treatment plants handling chemical wastes were installed by a German and two British chemical manufacturers. The former installation incorporates the first D-O equipment to be purchased for this purpose in Germany since World War II. Next year two Southern pulp mills will clarify wastes in giant 300 foot Thickeners installed in earthen basins, and a U. S. steel company will recover flue dust in a completely D-O designed installation. Two similar flue dust recovery stations were also ordered from our British subsidiary during the year.

The year's impressive record of sales and technical accomplishment has been made by the hard work of our staff in every corner of the globe. The success of our operations naturally rests wholly with them, despite the importance of the tangible facilities and tools with which we work. In the year now drawing to a close this was again demonstrated, and as the tools and facilities we give them expand and become of better quality, so will our staff be able to produce greater volume and increasing returns.

J. D. Hitch, Jr.
November 20, 1956 *President*

For more data on advertised products, use Readers' Service Cards, last page.

What's Happening. . .

(probably refiners and producers) will be represented.

After a meeting of the National Petroleum Council which he attended, Senator O'Mahoney (D-Wyo) said he felt "independents" would be given an actual seat on Middle East Emergency Committee. Presently, the committee is composed of 15 major U. S. oil companies which are acting together in an effort to bolster Europe's dwindling oil supply (PETROLEUM REFINER, Dec., p. 294).

Concerning any new additions to the 15-company MEEC membership, Defense Mobilizer Flemming said he will consider any new nominations which Interior may offer. He further added that he believes oil industry "independents" should be given full opportunity to know what is going on, and to make their views known to the government.

Senator O'Mahoney said foreign oil activities are sure to cause certain problems in domestic industry, and that the U. S. must carry out these emergency oil plans, "without disrupting our own domestic petroleum economy. After all," he added, "the U. S. is picking up the tab."

Need Help to Stay on Top

A four point program to insure U. S. maintenance of superior technological developments was suggested at a joint meeting of the American Institute of Chemists' New York chapter, and the Chemical Industry Association by Simon Askin, president, Heyden Chemical Corp. According to Askin, the U. S. chemical industry urgently needs help from the Administation on:

1. Tax relief to offset rising replacement costs of obsolete equipment which now deter research development.
2. More adequate tariff protection to insure U. S. independence of British and West-of-the-Rhine supply sources for chemicals essential to national defense.
3. Realistic exemption from selective service of technically trained men needed to continue technological development essential to survival.
4. Encouragement of qualified educators to adopt science teaching careers to insure a continuing supply of adequately trained personnel.

British Eye Internationals

International oil companies have gotten a hint of the kind of treatment they might expect from British Labor government if the present Conservative party is overthrown. Harold Wilson, opposition leader who would likely become Chancellor of the Exchequer in the event the Labor party comes into power, has called for an inquiry into oil pricing and practices by contending that recent hikes in oil prices in various companies have followed on the heels of each other and for the same amounts. He calls it, "an interesting set of circumstances."

Now is the time, Wilson contends, for the investigation if the Conservative government is serious about holding the line against inflation. He demanded an investigation into "the entirely unreal practices of the Middle East oil interests in basing their export price, not on the cost of production, but on the entirely irrevelant Gulf price in North America."

Another inquiry asked for by Wilson

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All Catawissa Unions are designed to give a 3-to-1 SAFETY FACTOR . . . 3,000-lb. service unions are tested to 9,000-lbs., 6,000-lb. service unions tested to 18,000-lbs., etc.
Exclusive Ball-to-Angle seat design assures a PERFECT SEAL even when the pipe is not in alignment!
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What's Happening . . .

was into "the wasteful advertising" of the oil companies.

OEEC Sets HQ in London

Organization for European Economic Cooperation will make London the base of its oil supply coordination for Western Europe in connection with the U. S. Middle East Emergency Committe's supply program (PETROLEUM REFINER, Dec., p. 294).

A policy meeting will be held every month of OEEC's Oil Committee, and OEEC Petroleum Emergency Group (regular members: British Petroleum, Shell, Cie. Francaise des Petroles). Small operating groups will meet every ten days or so while liaison to OEEC is maintained through a small staff in Paris.

London was chosen for OEEC oil operational center because two OPEG members, BP and Shell, have headquarters there, and the third member, Cie Francaise des Petroles, has an office there. U. S. international supplies also have offices in London.

OCAW Locals Get the Word

Start bargaining for a 27 cents an hour basic wage increase (about 10 percent), and "substantial improvement in fringe benefits" at "earliest possible moment." This is the latest directive to all local unions from the Bargaining Policy Committee of the Oil, Chemical, and Atomic Workers International Union.

Several Esso Standard (independent) groups on the East Coast had already spoken for a 10 percent hike with a 25 cents minimum, when OCAW's president O. A. Knight scheduled the Bargaining Policy Committee meeting to consider making a bid for a "substantial" increase (PETROLEUM REFINER, Nov., p. 265).

Now OCAW is out for the pay boost of 10.1 percent based on the gross average earnings of $2.67 as calculated by the union. The fringe benefits, however, are unspecified so far. The only light thrown on them was the OCAW statement that, "the Bargaining Policy Committee will, at the meeting, take action to implement through study of and careful preparation for future fringe benefits programs."

The committee has left it up to the local bargaining unit to, "apply the increase by such formula as it sees fit; that is, it may apply the increase in the form of a 27 cents an hour increase in all rates, on an equivalent percentage basis, or in combination of these forms."

The committee added, however, that each local group should start negotiations as soon as possible, "with the view of securing the increase within the very near future."

In compliance with the directive from the Policy Bargaining Committee, OCAW locals have begun calling on oil companies to set dates within the next 35 days for negotiations to begin.

The talks will get underway against a backdrop of domestic gasoline surplus, and an uncertain future in 1957, brought on by the Middle East crisis and the resulting European oil shortage. Also figuring in the talks will be higher oil company profits in 1956, and the increased use of automation.

So far, no oil company has made any counter offer to the OCAW demand, but chances of a strike appear remote, par-

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ticularly if the weather is cold during the negotiations. Refiners in that event will be in their period of high demand for heating oil for home furnaces. With the stocks of such fuel oil already down to "adequate" levels, and with the possibility for a growing European demand for such oil, the industry would be reluctant to let any plants shut down for fear of causing a heating oil shortage. If talks could be stretched out until March or April, when oil demand begins to decline, however, shutting of refineries would help to work off surplus gasoline supplies.

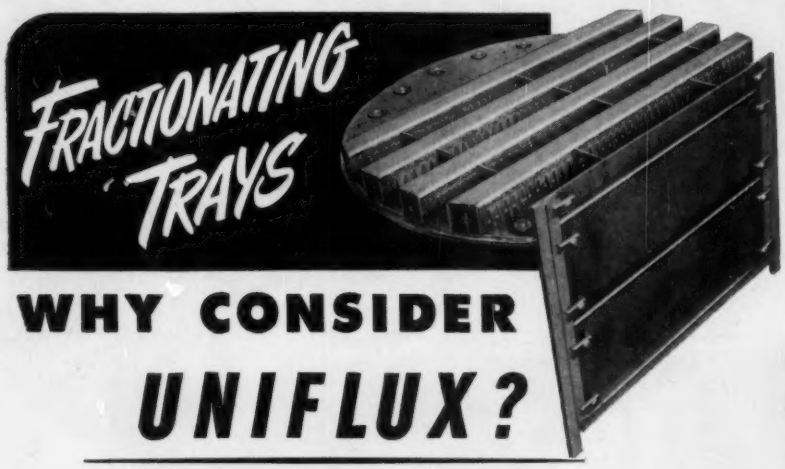
Meanwhile, in British Columbia, units of OCAW will seek a 27 cents wage boost just like brother locals in the U. S., although average refinery wage in B. C. is $2.20, or 47 cents less than the over-all industry wage average in the U. S.

Erratum

Equation (5) in A. L. Fuller's "Computer Evaluates Cooling Towers" which appeared at the bottom of page 213 in the December issue of PETROLEUM REFINER should have read as follows:

$$KaV/L = \int_{T_2}^{T_1} \frac{dT}{e^{1.77 + 0.025T} - (L/G)T + C} \qquad (5)$$

where $C = (L/G)T_2 - e^{1.77 + 0.025\,t_{2w}}$



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Eight Die In Plane Crash

Eight Phillips Petroleum Co. employes, including five men of the natural gas department, and an attorney, were killed Dec. 13, when a company plane crashed five miles south of Bartlesville, Okla.

The lost were, A. M. Rippel, manager of the Natural Gas department; C. W. Binckley, William C. Reed, Donald Young, and D. F. Mayfield of the Natural Gas department; George Sneed, attorney; Joe Bower, pilot; and R. E. Ulrich, co-pilot. All eight were headquartered in Bartlesville.

The plane, a two-engine Lockhead Lodestar, developed engine trouble soon after taking off from Bartlesville for Salt Lake City. It had circled to return to Bartlesville when it crashed and burned.

New TEL Process by Ethyl

A new process for making tetraethyl lead that has been described as radically different from any heretofore used is being developed by Ethyl Corp. The chemistry of the process involves a reaction between a metal alkyl and a lead compound.

According to Edward L. Shea, Ethyl president, the development work is still in its early stages, but the process shows considerable progress because it eliminates certain intermediate materials and steps involved in the present manufacturing operation, and has proven itself superior to all processes now known.

So far, Ethyl has not given out any technical details of its new process.

Three Conferences Slated

John S. Bonner of Bonner and Moore Engineering Associates will direct a two day computer sumposium at Oklahoma A & M, Stillwater, Okla., Jan. 14 and 15. The principal subject will be the development, interpretation and use of procedures for multicomponent plate to plate distillation calculation on the IBM 650 computer. Bonner has done extensive work on this field and published several papers on the subject. The symposium is being organized by Dr. R. N. Maddox of Oklahoma A & M, which recently installed an IBM type 650 computer. Demonstration of calculation procedures will be made on this machine.

The Chemical Market Research Association will hold a meeting at the new Sheraton Hotel in Philadelphia on February 19-20. The theme of the meeting is "Our Next Five Years of Competition with Foreign Chemical Industry." Well qualified speakers from industry and government bureaus will be on the program.

A symposium on "Instrumentation for the Process Industries" will be presented by Texas A&M College, College Station, Texas, January 23-25. The symposium has been designed to lead to an improved understanding of the principles and practice of instrumentation as applied in the industry. Particular attention will be given to new developments with talks directed toward all engineers whose work requires knowledge of industrial instrumentation.

The first annual conference on Statistical Quality control will be held in Houston on Feb. 16, by The South Texas Section of The American Society for Quality Control. With the cooperation of the Texas Manufacturers Association, the South Texas Section is initiating the annual conference in an effort to offer to the Texas Gulf Coast area authoritative

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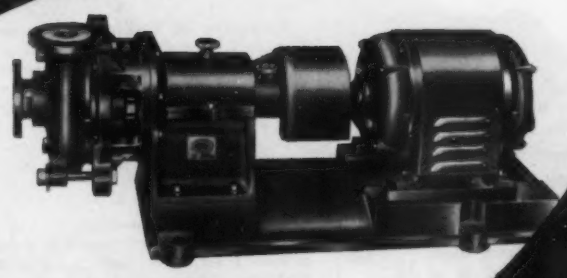

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What's Happening . . .

presentations of statistical methods and concepts as applied to industrial and management problems.

The conference has been arranged so that management and management personnel can attend only the morning sessions and still get the gist of the statistics. The technologists will be able to hear as many of the papers as their time permits.

Banquet speaker will be Dr. John J. McKetta who will speak on "Common Sense in Engineering." Dr. McKetta is chairman of the Chemical Engineering Department of the University of Texas. He is also chairman of the Editorial Committee of PETROLEUM REFINER.

Acetylene Process to U. S.

The petrochemical industry now has an opportunity to produce acetylene more efficiently through a licensing agreement consummated between Blaw-Knox Company, Chemical Plants Division, Pittsburgh, Pa., and Societe Belge de l'Azote (SBA) of Liege, Belgium.

According to Blaw-Knox, the new process offers better results in the manufacture of acetylene from natural gas, because it eliminates production headaches which have plagued other pyrolysis processes. Heart of the system is the SBA burner with a patented design that limits the formation and deposit of soot, which normally causes frequent shutdowns of the unit. Thus, operating costs are lower and maintenance minimized.

Additional economies are realized in the acetylene purification step of the process, which uses ammonia rather than more expensive solvents common to other processes. This feature also eliminates the difficulties usually encountered with diacetylene polymers and produces a cleaner product.

Changing Times

Superior Oil Co. and two of its attorneys have been found guilty of illegal lobbying activities in connection with the natural gas bill. A U. S. District Court fined Superior $10,000 while Elmer Patman and John J. Neff were fined $2500 each and received 12 month suspended jail sentences.

—•—

Properties of Anglo-Egyptian Oilfields, Ltd., a Royal Dutch Shell group member, **have been seized by the Egyptian government.** Anglo-Egyptian, which includes some British capital, produces crude oil from five fields in the Suez graben and runs a 41,000 b/d refinery at Suez.

—•—

Isomerization will be the leading process discussed at the mid-year meeting of API Refining division, May 13-16 in Philadelphia. Preliminary program listing includes Indiana Standard's Isomate process, Kellogg's Iso-Kel process, and UOP's Penex process. Other isomerization papers will be presented by Atlantic Refining and Houdry.

—•—

The Texas Company has created a new regional office of its Research and Technical department to serve 14 eastern and middle Atlantic states. **The new headquarters in Beacon, N. Y.,** has named R. J. Ronan regional manager-technical services. Main department function is to seek ways of improving fuels and lubricants.

—•—

Rubber Manufacturers Association has estimated that 50 percent of the world's rubber requirements by 1965 will have to be supplied by synthetic rubber. It foresees world rubber demand reaching 4 million long tons a year within the next ten years, but doesn't expect world natural rubber output to rise above the 2 million ton mark by then.

—•—

Employes of Phillips Petroleum Co.'s Kansas City refinery have completed one million consecutive man-hours of work with no time lost due to an injury. This record was established over a period of 191 days beginning June 7, 1956. It is the fifth million man-hour safety achievement established by the refinery employes since May 1948.

—•—

California's Proposition 4—the oil and gas conservation act that was defeated by a 4 to 1 ratio **was quite an expensive investment.** Sponsors of the measure spent $3.4 million with most of the money being put up by major oil companies. Union Oil Co. and other opponents of the proposition spent $1.4 million.

—•—

Socony Mobil Oil Co., Inc., is revamping its employe savings plan so employe holders of company stock will be able to vote their shares through the plan's trustee. The change is one of several contemplated in employe benefits, all of which

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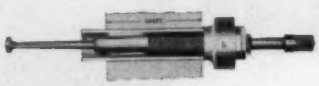

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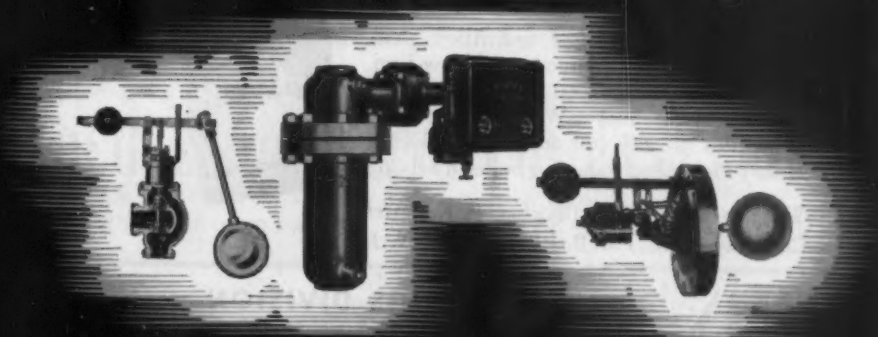

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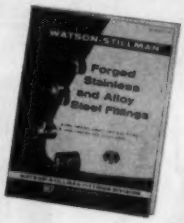

W-S Forged Stainless and Alloy Steel Fittings can be obtained in Screw-End Type for 2,000 lb., 3,000 lb., and 6,000 lb. WOG service; Socket-Welding Type for Schedules 40, 80, 160 and Double-Extra Heavy Pipe. Send today for bulletin S-1-55.

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What's Happening . . .

are contingent upon Internal Revenue approval.

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Shamrock Petroleum Co., which recently announced plans to build a refinery at Haines, Alaska, **has changed its name to Alaska-Yukon Refiners & Distributors, Ltd. . . . Frontier Chemical Co.** has shipped the first carload of products from its new chlorinated solvents plant at Wichita, Kan. Comprising drum lots of carbon tetrachloride, **company claims first use in chemical industry** of a steel drum marked with calibrated measuring scale. . . . **a new catalyst,** Aero H.D.S. introduced by **American Cyanamid.** Company claims high-volume activity and mechanical properties permit refiners to get **longer on stream service life . . . Seiberling Rubber Co.**'s plastic division, Newcomerstown, Ohio, **now producing polyethylene** for vacuum formed products . . . **Budd Co.**, Philadelphia, **first commercial facility** in this county **to fabricate radioisotopes** in strengths up to 10,000 curies . . . **Ethyl Corp. has laid off some 235 employes** at Baton Rouge and Houston plants. **Reasons given:** lower than expected demand for TEL, and declining market for sodium by detergent manufacturers . . . **Queen City Refining Co. plans to reopen its 2500 b/d refinery** at Dickinson, N. D. Plant was closed last February for maintenance, then company was reorganized.

Changes In Ownership

Chicago Corp., Ft. Worth, will merge with its wholly owned subsidiary, **Champlin Refining Co.**, and change its name to **Champlin Oil & Refining Co.** Chicago acquired Champlin about two years ago and recently completed a modernization program at the Enid, Okla., plant.

General Tire and Rubber Co. has acquired **Lawrence Process Co.**, North Andover, Mass., for the purpose of expanding its plastics business.

The Petro-Atlas Corp., wholly owned subsidiary of financier Floyd Odlum's **Atlas Corp.** is acquiring controlling stock in El Dorado Refining Co. The latter has a 16,000 b/d refinery at El Dorado, Kan., a 1700 b/d crude production, and a pipe line gathering system.

Pioneer Natural Gas Co. has acquired **Pioneer Gathering System, Inc.** C. I. Wall, Pioneer Natural president also announced formation of Pioneer Production Co., which has contract to sell Pioneer Gathering substantial volumes of gas.

Northwest Production Corp. has acquired the assets of **Barnhart Hydrocarbon Corp.** which operates a gasoline plant in Regan County, Texas. Barnhart will become a wholly owned subsidiary of Northwest which is a production subsidiary of Pacific Northwest Pipeline Corp. The Barnhart plant processes about 25 million cubic feet of residue gas and 55,000 gallons of heavy hydrocarbon per day.

American Petrofina, U. S. branch of the giant Belgium oil tree, has completed negotiations for acquiring **American Liberty Oil Co.**, Dallas. Liberty's facilities are small, but fit well with what Petrofina got when it took over **Panhandle Oil Corp.** earlier. Petrofina will operate ac-

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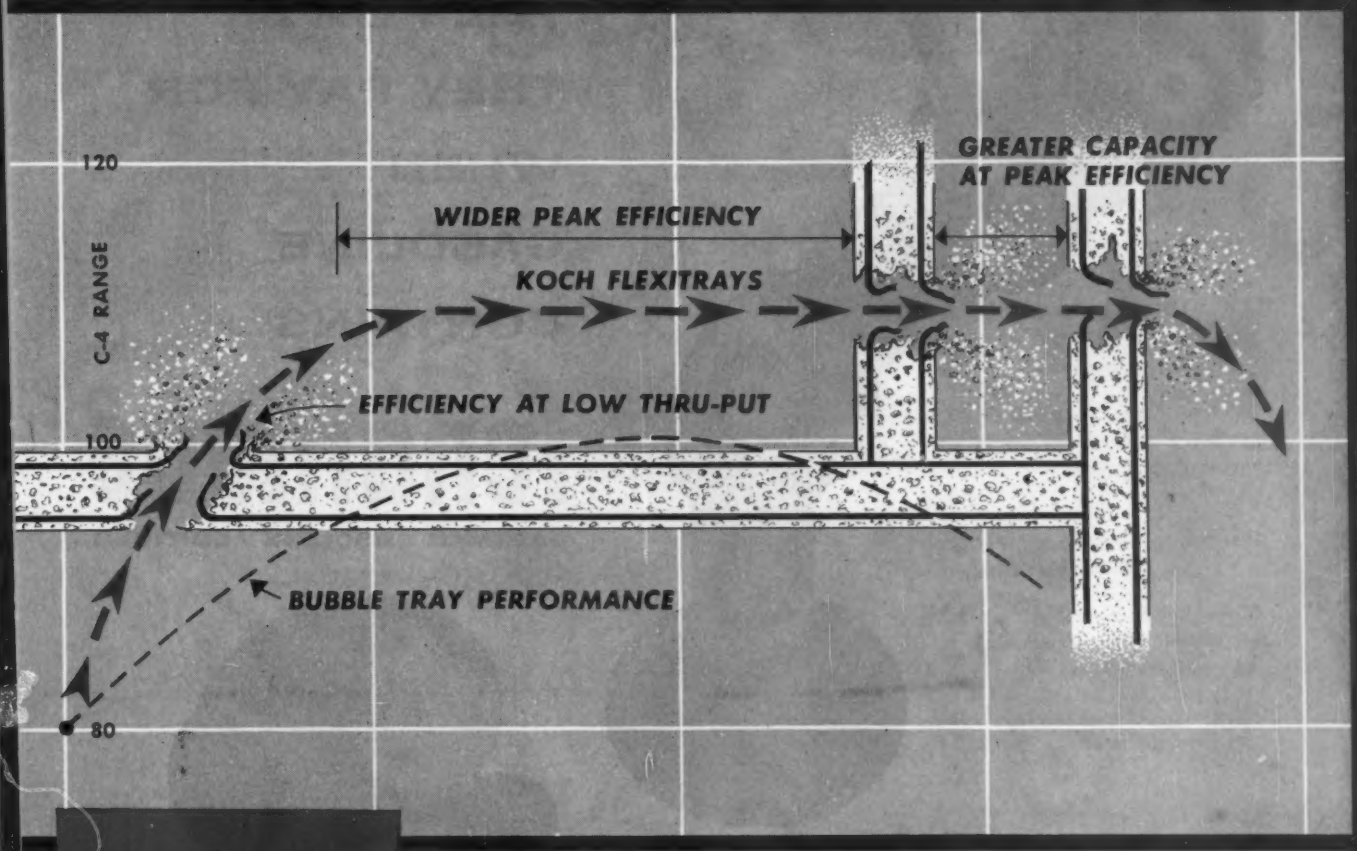

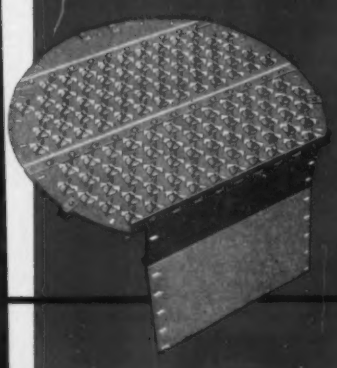

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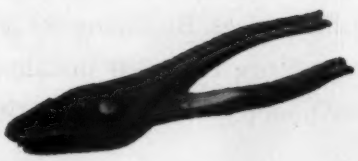

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SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

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quired companies as divisions of the parent concern under their established names. Will probably be, therefore, some time before company's well known international brand "Fina" hits the U. S.

MEETINGS CALENDAR

JAN.	
21–25	American Institute of Electrical Engineers, 1957 Winter General Meeting, Hotel Statler, New York City.
23–25	Instrumentation for the Process Industries Symposium, Texas A & M College, College Station, Texas.
28–30	Eighth Plant Maintenance and Engineering Conference, Statler Hotel, Cleveland.
31–Feb. 1	Sixth Annual Instrument Short Course, Los Angeles Harbor Junior College, Wilmington, Calif.
FEB.	
4– 8	American Society for Testing Materials Committee Week, Benjamin Franklin Hotel, Cleveland.
5– 7	Twelfth Annual Technical and Management Conference of the Reinforced Plastics Division of The Society of the Plastics Industry, Inc., Edgewater Beach Hotel, Chicago.
7– 8	Gulf Coast Regional Technical-Industrial Relations Meeting of the Western Petroleum Refiners Association, Lamar Hotel, Houston.
10–16	ASTM Committee Meeting on Petroleum Products, New Orleans.
13–15	American Society for Quality Control Study Course, Lamar Hotel, Houston.
14–16	American Association of Cost Engineers, Board of Directors, Winter Meeting, New York City.
19–20	Chemical Market Research Association Meeting, New Sheraton Hotel, Philadelphia.
22	Natural Gasoline Association of America, Permian Basin Regional Meeting, Scharbauer Hotel, Midland, Texas.
MAR.	
3– 6	American Institute of Chemical Engineers, Greenbriar Hotel, White Sulphur Springs, Virginia.
4– 8	Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Penn-Sheraton Hotel, Pittsburgh.
10–13	American Institute of Chemical Engineers, Greenbriar Hotel, White Sulphur Springs, Va.
11–15	Chemical Industry Symposium of 13th Annual Conference and Exhibition of the National Association of Corrosion Engineers, Kiel Auditorium, St. Louis.
11–15	Nuclear Congress, Convention Hall, Philadelphia.
18–21	Society of Plastics Industry, Annual Conference and Pacific Coast Plastics Exposition, Shrine Exposition Hall, Los Angeles.
25–27	Western Petroleum Refiners Association, 45th Annual Meeting, Hilton Hotel, San Antonio, Texas.
25–29	Tenth Western Metal Exposition and Congress, American Society for Metals and Other Technical Groups. Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles.
27–29	American Power Conference, Annual Meeting, Sponsored by Illinois Institute of Technology, Hotel Sherman, Chicago.
APRIL	
2– 4	Corrosion Control Short Course, University of Oklahoma Extension Study Center, Norman.
7–12	American Chemical Society, 131st Annual Meeting, Miami, site unreported.
8–12	American Welding Society, Spring Technical, National and Welding Show, Sheraton and Bellevue-Stratford Hotels, Philadelphia.
16–18	National Petroleum Association, Semi-Annual Meeting, Cleveland Hotel, Cleveland.
24–26	National Gasoline Association of America, 36th Annual Convention, Rice Hotel, Houston.
28–30	Independent Petroleum Association of America, Midyear Meeting, Buena Vista Hotel, Biloxi, Miss.
29–May 1	American Oil Chemists' Society Annual Meeting, Roosevelt Hotel, New Orleans.

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NP 856—150# Stainless Steel Screwed Fittings, Flanged Fittings and Flanges to MSS Standards, for standard pressure-service requirements.

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What's Happening . . .

. . . *Among Men* in the Industry

A. S. (Steve) Gilliam has been appointed plant manager of Great Northern Oil Co.'s Pine Bend refinery, Pine Bend, Minn. Gilliam has recently been project manager and assistant plant manager of the Olin-Mathieson Chemical Corp., Morgantown, W. V., where he worked for the past six years. Previous to that he was with the Shell Oil Co. at Houston, and Wood River, Ill.

A. S. (Steve) Gilliam

A member of the American Institute of Chemical Engineers, Gilliam is also active in the American Management Association and is a member of the Illinois Society of Professional Engineers.

Glenn O. Hayes has been appointed to the newly created position of director of employee relations. Hayes, formerly resident manager of the company's Houston manufacturing plant, will make his headquarters in New York. **Curtis R. Holton,** formerly director of industrial relations, has resigned to open his own consulting firm.

The newly organized Employee Relations department will act as a service department for the entire company. At Baton Rouge, it will be represented by **W. J. Henry,** and at Houston by **D. J. Kennedy.**

In other company changes, **Melvin C. Hudgins** became resident manager of the Houston plant and **Jasper F. Kobler** became assistant resident manager.

J. W. Hyde, assistant superintendent-operations, has been promoted to plant superintendent, replacing **H. E. Hughes** at Shell Chemical Corp.'s Houston plant. Hughes has been transferred to Shell Chemical's Denver, Colorado, plant, where he will assume position of plant manager.

D. N. Rindsberg will move to assistant superintendent-operations from his present duties as assistant superintendent-technical.

Hyde joined Shell 18 years ago in California. After 12 years of service in that area, he was transferred to the Houston plant as a senior engineer, and since that time has been assistant chief engineer, chief engineer and assistant superintendent-operations.

Rindsberg joined Shell at the Houston plant in 1942 as an analytical chemist. He has held positions as technologist, department manager-operations, and assistant superintendent-technical.

G. L. Farnsworth, asphalt sales manager of Husky Oil Co., has been elected vice president of Division 3 of The Asphalt Institute. Farnsworth has been an active member of The Asphalt Institute for many years. He has been with Husky as asphalt sales manager since 1947. Prior to that he held asphalt managerial and research positions with Idaho Refining Co., Skelly Oil Co., and Socony-Vacuum. He is a native of Oklahoma, and was educated at Kansas State College.

Benjamin M. Holt has been appointed to the newly-created post of Project Director of the Planning and Development department of American Potash & Chemical Corp. In this position, Holt will be in charge of special major projects being developed by the company.

Holt was with the Ralph M. Parsons Co. prior to joining American Potash & Chemical. He graduated from Stanford University with a B.A. degree, later receiving an M.S. degree from Massachusetts Institute of Technology.

Dr. Edgar C. Britton has retired as director of The Dow Chemical Co.'s Edgar C. Britton Organic Research Laboratory at Midland, Texas. He will be succeeded as laboratory director by **Dr. Ralph P. Perkins,** formerly an assistant director.

Dr. Britton, who received the Perkin Medal, industrial chemistry's highest award, in September, will continue as a member of the company's Agricutural Chemicals executive committee and as a board member and secretary of Dow Corning Corp., a Dow associated company.

M. C. Hewett

J. V. Evans

Merritt C. Hewett, a 21-year veteran of American Oil Co., has been named assistant manager of asphalt sales for the company. Hewett, who formerly served as director of research and development at the company's asphalt research laboratory in Baltimore for 11 years, will assist **Forrest G. Heath,** manager of asphalt sales.

Hewett joined the company in 1935 as an asphalt research chemist at the Baltimore laboratory. In 1942, he was appointed chemical engineer at the company's research and development department in Texas City, and returned to Baltimore in 1945 to head the asphalt research laboratory.

A native of Oklahoma City, Okla., Hewett graduated from the University of Oklahoma with a B.S. degree in chemical engineering and an M.S. degree in chemistry in 1933.

James V. Evans will succeed Hewett as director of the company's asphalt research laboratory at Baltimore. Evans joined the company in 1950 as a chemical engineer and was named assistant to the director of the asphalt research laboratory at Baltimore in 1953. He held that position until his latest promotion.

Evans was born in Muskogee, Okla., and graduated from the University of Oklahoma where he received a B.S. degree in 1949 and an M.S. degree in 1950.

A. J. Wood has been named superintendent-operations at Shell Oil Company's Houston refinery. Wood, now chief technologist at Shell's Wood River, Ill., refinery, succeeds **J. L. Miller,** whose promotion to manager of Shell Oil Co. of Canada, Ltd.'s refinery at Montreal was announced.

A. J. Wood

After graduating from the University of Illinois, Wood joined Shell in 1938 as a technologist at the Wood River refinery. He has spent his entire Shell career at that location, rising through increasingly responsible positions to his post as chief technologist.

Harold G. Teverbaugh has been appointed vice president of Texas Natural Gasoline Corp. In his new position, Teverbaugh will be mainly concerned with administrative and supervisory work for the engineering and gas department.

Teverbaugh joined Texas Natural in November, 1953, as assistant manager of the gas division. He was later promoted to chief engineer, and in June, 1956, was made general superintendent.

David W. Young has been appointed research associate of Sinclair Research Laboratories, Inc., Harvey, Ill. Young joined Sinclair last year after more than 20 years of research work on petroleum products and processes. He holds 150 patents covering a wide range of developments in the fields of oil and petrochemicals. He was born in Oblong, Ill., and later moved to Lexington, Ky. He graduated from the University of Kentucky in 1931 with a B.S. degree in industrial chemistry and four years later received his M.S. degree in chemistry.

Young remained at the university until 1936 as an instructor in the chemistry department. From 1936 to 1940, he was employed by General Chemical Co., New York, and from 1940 to 1955 was in the chemical division of Esso Research and Engineering Co., Linden, N. J.

E. F. Koenig has been appointed technical representative of the Technical Services division of The Texas Company's Research and Technical department.

In his new position, Koenig will specialize in the field of additives for petroleum lubricants. Texaco is now building a large additives manufacturing unit at its Port Arthur, Texas, works, largest of the company's 11 refineries in the United States.

Robert L. Kidd, Bartlesville, Okla., and **Harry D. Hancock,** New York, have been elected directors of Cities Service Co. Kidd is president of Cities Service Oil Co. (Del.), principal oil and natural gas producing subsidiary of the Cities Service

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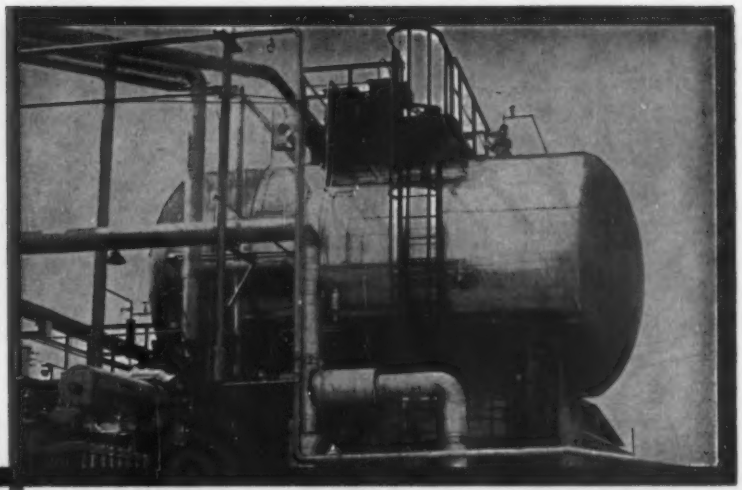

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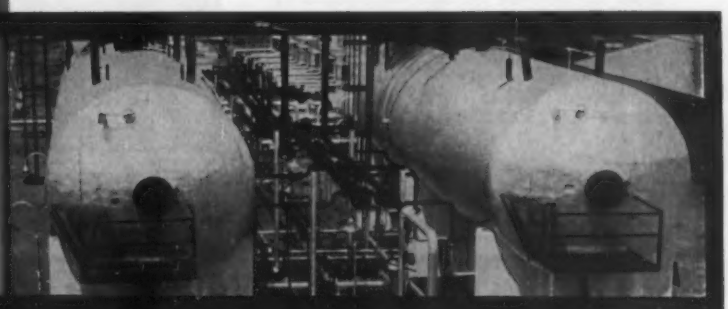

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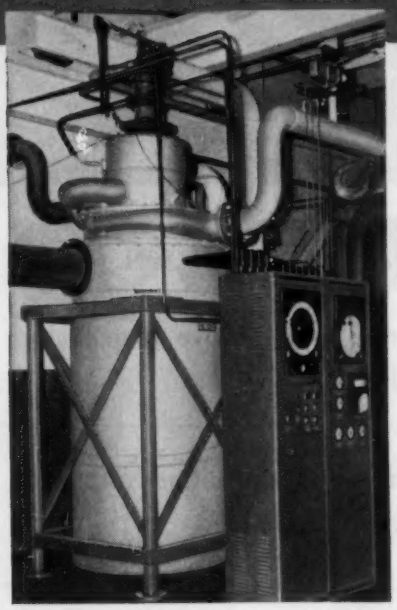
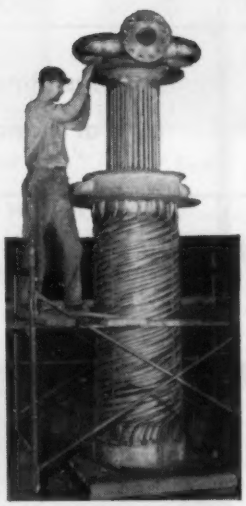


a compact means of heating air or process gases for testing or production



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Whether it be an existing standard design or a unit for special requirements, THERMAL heat exchangers provide the ultimate in compactness, high performance and response. These heat exchangers are always designed around the high velocity, clear flame combustion characteristics of THERMAL burners. Convection is thus the primary means of heat transfer thereby promoting uniform metal temperature and long life. THERMAL Heat Exchangers are supplied as complete package installations including all control and accessory equipment.

DESIGNS AVAILABLE FOR:

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REPRESENTATIVES IN PRINCIPAL CITIES

Men in the Industry...

system, and Hancock is president of Cities Service Gas Co.

Born in Brazil, Ind., and a graduate of Indiana University, Kidd joined the Cities Service organization in 1925 as a geologist. He progressed through a series of assignments in various areas of the company's operations, and was elected president of Cities Service Oil Co. (Del.) in July, 1956.

A native of Higginsville, Mo., Hancock graduated from the University of Missouri with a bachelor of science degree, then joined Denver Gas and Electric Co. in 1912. After assignments with Cities Service companies, he became manager of the Natural Gas department of Cities Service Petroleum, Inc., in 1955 and served in this position until November of this year when he was elected president of Cities Service Gas Co.

H. E. Hughes, superintendent of Shell Chemical Corp.'s Houston plant, has been named manager of the company's Denver plant, succeeding **J. G. Bejarano,** who died last month. **J. W. Hyde,** assistant superintendent, operations, at Houston, will assume the superintendent's position.

F. G. Watson will become assistant manager of manufacturing development and will be succeeded in his present post by **C. H. Plomteaux,** assistant superintendent at Shell Chemical's Norco plant.

L. L. Patterson, Blackwell, Okla., has been appointed production superintendent of Cities Service Oil Co.'s Ambrose gasoline plant near Blackwell. Patterson graduated from Oklahoma University with a degree in chemical engineering and was employed by Cities Service in 1950. He was named plant engineer at the Ambrose plant in 1951.

R. P. Barry, Jr. has been named superintendent of the chemicals and plastics resins plant at Seadrift, Texas, of Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp.

Barry has been assistant superintendent and succeeds **Dr. C. M. Blair** who is being assigned to the New York headquarters.

Before his assignment to the Seadrift plant in 1952, Barry has been an area supervisor of chemical production at Carbide's South Charleston, W. Va., plant. He joined Carbide in 1936 after graduation from Vanderbilt University with a M.S. degree in chemical engineering.

N. C. Kymes has been named superintendent of the Fittstown, Okla., natural gasoline plant of Kerr-McGee Oil Industries, Inc. He succeeds **Fred Fox,** who resigned to accept a position at Kendrick, Okla. **Kenneth Smith** has been named to fill Kymes' former position as field superintendent of the Milfay, Okla., plant.

Other personnel changes announced were: **Harry Hamilton,** formerly gas tester, as chief gas tester and scout; **Othell Flatt,** former office manager at the Pampa, Texas, plant as gas tester at Milfay; and **Gene Gessner** as engineering staff assistant.

Carl W. Peters, formerly chief process engineer, has been promoted to technical director of Pan-Am Southern Corp.'s Destrehan, La., refinery. Peters replaces **H. A. Parker,** who has been transfrred to New York as assistant manager of operations in

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Refiners and blenders rely on Enjay Paratone for compounding oils that combine cold-weather, quick-starting properties with low consumption characteristics.

You can also count on Enjay for a prompt solution to your additive problems. The Enjay Company, pioneer in petroleum additives, has extensive experience in working with oil companies and leading engine manufacturers to develop additive formulations. Whatever your use of additives, you can benefit from this experience.

For complete information, write or call the Enjay Company—your only source of a *complete* line of additives (Paramins®) for fuels and lubricants.

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Men in the Industry...

the manufacturing department of American Oil Co.

Also, **John H. Bryant** has been named group leader in charge of coordination and economics, and **William E. McWhirter** appointed to group leader of technical service and process engineering. Both men held positions as process engineers.

Peters joined Standard Oil Co. (Indiana), parent company of Pan-Am at its Whiting, Ind., refinery in 1942. He was transferred to Pan-Am's general office in New Orleans in 1951, and in 1953 was transferred to Destrehan. Bryant has been associated with Pan-Am since 1948, and McWhirter since 1951.

Hinton J. Dillard, Denver, has been promoted to resident chemist of Continental Oil Co.'s Denver refinery. Formerly assistant chemist at the Denver refinery, he will be succeeded by **Robert Schlessman,** Wichita Falls, Texas.

Dillard joined Conoco in 1949 as an analytical chemist at Ponca City, Okla., and transferred to Denver in 1951. A native of Bolton, Miss., he graduated in 1948 from Mississippi College, where he majored in chemistry and physics.

Schlessman became associated with Conoco in Denver in 1948 and transferred to the company's Lake Charles, La., refinery in 1953. He has been assistant chemist at Conoco's Wichita Falls refinery since 1954. He graduated in 1943 from Colorado Agricultural and Mechanical College, where he majored in chemistry.

Odell Campbell, former manager of laboratories for E. I. du Pont de Nemours and Co., Inc., Tulsa, has joined Kerr-McGee Oil Industries, Inc., Oklahoma City, as technical assistant to **R. M. Chesney,** vice president in charge of refining.

Dr. Charles H. Riesz, has been promoted to senior scientist at Armour Research Foundation of Illinois Institute of Technology, Chicago.

Riesz joined the Foundation in 1952 after leaving the Institute of Gas Technology, where, since his appointment in 1941, he had investigated numerous catalytic applications to the utility gas industry.

He received his doctorate in chemical engineering from Armour Institute of Technology, now Illinois Tech, in 1939.

Dr. Sherman S. Shaffer, staff associate in the technical and research divisions of Humble Oil and Refining Co., Baytown, Texas, has been elected chairman of the American Chemical Society's Division of Petroleum Chemistry for 1957. He succeeds **Dr. Alex G. Oblad,** manager of research and development of the Houdry Process Corp., Marcus Hook, Pa.

Harold M. Smith, assistant supervising engineer of the U. S. Bureau of Mines, Bartlesville, Okla., was named chairman-elect and **Wheeler G. Lovell,** director of automotive products development of The Ethyl Corp., Detroit, was re-elected secretary-treasurer.

Warren A. Beman has been appointed to head the marketing division and Frederick P. Richter has been named head of the technical division of the recently established petroleum chemicals department of Socony Mobil Oil Co., Inc.

Beman has been head of the process products group in the industrial division of Socony Mobil's lubricating department since 1954. A chemical engineering graduate of Purdue University, he joined the company in 1942.

Dr. Richter was supervisor of the chemical section of the company's Research and Development Laboratory at Paulsboro, N. J. More recently he was a member of the technical staff of the manufacturing department of General Petroleum Corp., Socony Mobil's West Coast affiliate. He holds B.A. and M.A. degrees in chemistry from Temple University and received a Ph.D. in chemistry from the University of Illinois in 1941.

I. W. Scroggin, New York, has been appointed assistant plant manager in charge of technical services for the Cities Service refinery at East Chicago, Ind. He was first employed by Cities Service in 1946 and served as process engineer at the Cities Service Refining Corp. refinery at Lake Charles, La., until 1951. At that time, he was transferred to the manufacturing department of Cities Service Petroleum, Inc., in New York. He is serving there as staff engineer.

Everett M. Barber, inventor of the Texaco combustion process, and supervisor of special engine research at the Texaco Research Center, Beacon, N. Y., was presented with the Richards Memorial Award by the American Society of Mechanical Engineers on Nov. 28.

The Richards Memorial Award is given

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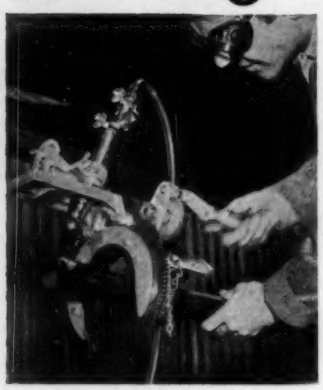
a Pipe Beveler with a Cutting Range of 1½" to 4"



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Employing the same split-gear horseshoe principle which has made its larger models so popular for years, H & M now offers the maximum in speed and *quality* of *bevels* for beveling small-diameter pipe! Built to withstand any job conditions, the H & M Model "O" can be operated easily and efficiently by unskilled operators — *with perfect bevels every time!* Change from one size of pipe to another can be made in a matter of seconds, with precision-made adapters, and a quick operating boomer strap allows rapid transfer from one pipe to another. *For detailed information on the fast-selling Model "O", contact your nearest H & M dealer immediately, or contact the factory at once!*

Other "light as a feather" H & M models save Time-Money on Pipe from 4" to 36"

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Men in the Industry . . .

annually to the mechanical engineer who has shown outstanding achievement within 20 to 25 years following graduation from a regular mechanical engineering curriculum in a recognized college or university.

Barber, a native of Oil City, Pa., received his B.S. degree in mechanical engineering from the Pennsylvania State University in 1931 and his M.S. degree in 1933. He joined the Texaco Research Center that year and has been there since, except for 1936-37, when he was a Gordon McKay fellow at the Harvard Graduate School of Engineering.

Arthur M. Griswold has been appointed manager of foreign research operations on the executive research staff of The Dow Chemical Co. Griswold has been section superintendent of Dowicide products for a number of years.

Griswold joined Dow in 1928 after receiving his B.S. degree in 1926 and M.S. degree in 1927 from Northwestern University. Early in his career he was associated with the production of phenetidine and phenacetin. Over the years he has been instrumental in guiding about 70 products new to the company through the development stage and into commercial production.

Tom F. Davenport, Jr., Robert H. Waixel, and **Gus Nichols** have joined the Research and Development department of the American Oil Co.

Davenport will receive a Ph.D. degree in chemistry from the University of Texas in June; he received a B.S. degree in chemistry from Georgia Institute of Technology in 1951.

Waixel, who was previously employed by Jefferson Chemicals Co., received a B.S. degree in chemical engineering from Purdue University in 1949.

Nichols, who is a native of Greece, obtained a degree in chemistry from the University of Athens in 1954. He served with the Greek Navy on a destroyer and as a petroleum chemist.

Dr. J. Henry Rushton, professor chemical engineering, Purdue University, has been elected 1957 president of the AIChE. **George E. Holbrook,** assistant general manager of the Organic Chemical department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has been elected vice president; **Dr. George G. Brown,** dean of the College of Engineering, University of Michigan, re-elected treasurer, and **F. J. Van Antwerpen,** Nutley, N. J., re-elected secretary.

Those elected as directors were: **John J. Healy, Jr.,** assistant to the vice president, Research Development and Engineering, Monsanto Chemical Co., St. Louis, Mo.; **Manson Benedict,** professor of nuclear engineering, Massachusetts Institute of Technology; **Richard H. Wilhelm,** professor and chairman of the Chemical Engineering department, Princeton University, and **J. H. Koffolt,** professor and chairman of department of Chemical Engineering, Ohio State University.

Dr. Alan S. Horowitz, and **Dr. Peter R. Taussig** have joined the staff of the Ohio Oil Co.'s Research Center.

Horowitz, a research geologist, is a native of Ashland, Ky., and completed studies at Washington and Lee University,

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FLOMIX®
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— patented (U. S. Pat. No. 2183859)
VERSATILE
— has mixed solutions from clay slip to penicillin.
HIGH CAPACITY
— installations in excess of 400 GPM and viscosities of 75,000 SSU.
PRESSURES
— to 400 psi — higher pressures possible.
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— to 300° C.
Use Nettco Flomix to combine liquids, gases and liquids, and liquids and solids as they flow through a pipe line. Flomix gives you these important advantages: ❶ fast, uninterrupted processing, ❷ increased uniformity of product, ❸ simplified piping layouts, ❹ complete elimination of intermediate storage tanks and mixing vessels, and ❺ reduced maintenance.
Nettco Agitation Engineers are ready to discuss the application of Nettco Flomix to your continuous processing problems: for mixing, blending, reacting, washing, contacting, bleaching, absorbing, chlorinating, clarifying.
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Men in the Industry . . .

Ohio State University and the University of Indiana, where he will officially receive his doctorate following the present term.

Taussig, a research chemist, is a native of Highland Park, Ill. He attended Antioch College, Ohio, and received his Ph.D. degree in organic chemistry from Cornell University this year.

Bonner

Moore

John S. Bonner and **J. S. Moore** have formed the firm of Bonner and Moore Engineering Associates, Houston, consultants in chemical engineering and computer applications development and supervision technical computing activities.

Bonner received a B.S. degree in chemical engineering from MIT in 1950, and attended California Institute of Technology for one year. His last two years have been devoted to the development of techniques for the application of electronic computers to engineering and refining problem.

J. F. Moore received his B.S. degree in 1952 from MIT. He joined Humble Oil & Refining Co. in the technical service division. Experience has been in manufacturing, refinery economics, and process refinery design which includes design of lube plants, propane deasphalting units, hydrodesulfurization units distillation and reformers.

William F. Kenney, New York, vice president and general counsel of Shell Oil Co., has been elected 1957 chairman of the American Petroleum Industries Committee of the API. He succeeds **Robert H. Scholl,** vice president and director of Esso Standard Oil Co., who has been chairman the past two years.

Henry L. O'Brien, New York, general counsel and director of Cities Service Co., was chosen to succeed Kenney as APIC vice chairman.

Kenney has been a member of the committee since January, 1953, and vice chairman since 1955. He joined Shell's legal staff at St. Louis in 1937, and after serving there and at Houston, was transferred to the New York office in 1945. In 1946 he was named manager of the legal department and assistant secretary of the company, then general attorney, and in January, 1953, became vice president and general counsel.

O'Brien, who has been a member of the APIC since January, 1955, is a native of Brooklyn, N. Y., and a graduate of Cornell University. He became vice president and a director of Cities Service Co. in 1940, and since 1950 has been general counsel, director and a member of the executive committee.

Dr. Ellis K. Fields has been appointed a group leader in the Standard Oil Co. (Indiana) research department at Whiting, Ind. Dr. Ellis is in the organic research division and will work with others in exploratory research in the field of high octane hydrocarbons and petrochemicals.

Dr. Ellis joined Indiana Standard in 1950. He is a graduate of the University of Chicago where he also studied for his Ph.D. degree in organic chemistry, which was conferred in 1938. He is a member of the American Chemical Society and American Association for the Advancement of Science.

J. L. Miller, superintendent operations at Shell Oil Co.'s Houston refinery, has been named manager of the Montreal refinery of Shell Oil Co. of Canada, Ltd. He succeeds **L. T. Wilson,** who has been given a special assignment.

Succeeding Miller as superintendent operations at the Houston refinery is **A. J. Wood,** chief technologist at the Wood River refinery. **J. W. Sheehan,** senior technologist, head office manufacturing technological department, will fill Wood's vacated position.

Eric G. Lindroth has been named director and senior vice president of Esso Export Corporation and appointed to the Esso Export executive committee. He has been with Jersey Standard and affiliated firms since 1932, and has been a director and treasurer of Esso Export since 1948.

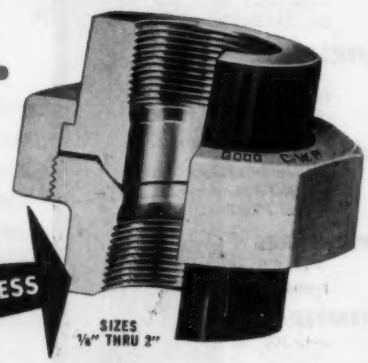
Guy B. Hunter, president of Quaker State Oil Refining Corporation, Oil City, Pa., was re-elected president of the National Petroleum Association at the 54th annual meeting in Atlantic City. This will be Hunter's second term in office. Other officers re-elected at a board of trustees meeting were: first vice president, **Paul R. Beck,** Pennsylvania Refining Corporation, Butler, Pa.; second vice president, **Rexford S. Blazer,** Ashland Oil & Refining Company, Ashland, Ky., and treasurer, **Guy B. Hunter.**

William F. Ryan has been installed as president of the American Society of Mechanical Engineers. Ryan is vice president, director, and senior consulting engineer of Stone and Webster Engineering Corp., New York. At the same business meeting of the ASME Council during its annual meeting the following officers were also installed: technical director, **Eugene W. Jacobson,** chief design engineer, Gulf Research and Development Co., Pittsburgh; administrative director, **V. Weaver Smith,** vice president in charge of contracts, Lummus Co., New York; four regional vice presidents, **William H. Byrne,** president and chairman of Byrne Associates, New York, **James H. Sams,** dean of engineering, Clemson College, South Carolina, **Rolland S. Stover,** owner, R. S. Stover Co., Marshalltown, Iowa and **Clifford H. Shumaker,** chairman, Department of Industrial Engineering, Southern Methodist University, Dallas.

R. K. Turner, a vice-president of Bakelite Co., has been appointed a vice president of Carbide and Carbon Chemicals Co. Turner's activities will be concerned with plastics operations of both companies which are divisions of Union Carbide and Carbon Corp.

Turner began with Union Carbide in

NEW petro
6000 LBS.
C.W.P.
FORGED STEEL UNIONS
Ideal for High Pressures of Gases or Liquids, Hot Oils, High Temperatures, Ammonia Hot or Cold & Power Piping



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SIZES 1/8" THRU 2"

● The wall thickness of this New Petro Union has been greatly increased to easily withstand the severe demands of higher pressures and hot or cold temperatures. It is drop forged from uniformly heated steel forging bars. Grain and fibre structure are refined through the controlled hammer impact on the hot, plastic metal as it is confined in the closed dies. The hot forging develops the tensile and torsional strength, the toughness and fatigue endurance required to enable the finished Union to resist the most complex stresses and strains ever present in high pressure and high temperature piping systems.
● Nuts are octagon in shape and are Udylited. The nut threads are rust-proof, spark-proof and permanently lubricated with Udylite Cadmium.
● The ends are also octagon in shape to provide flat gripping areas for wrenches.
● The ends are tapped, sharp and clean, per American Standard B 2-1 1945 (for tapered pipe threads).

THE "ECONOMY PLUS" UNION

You'll get greater ruggedness, dependability and service with a minimum of downtime or maintenance time. Considering the original low cost it's the most economical Union you will ever buy.

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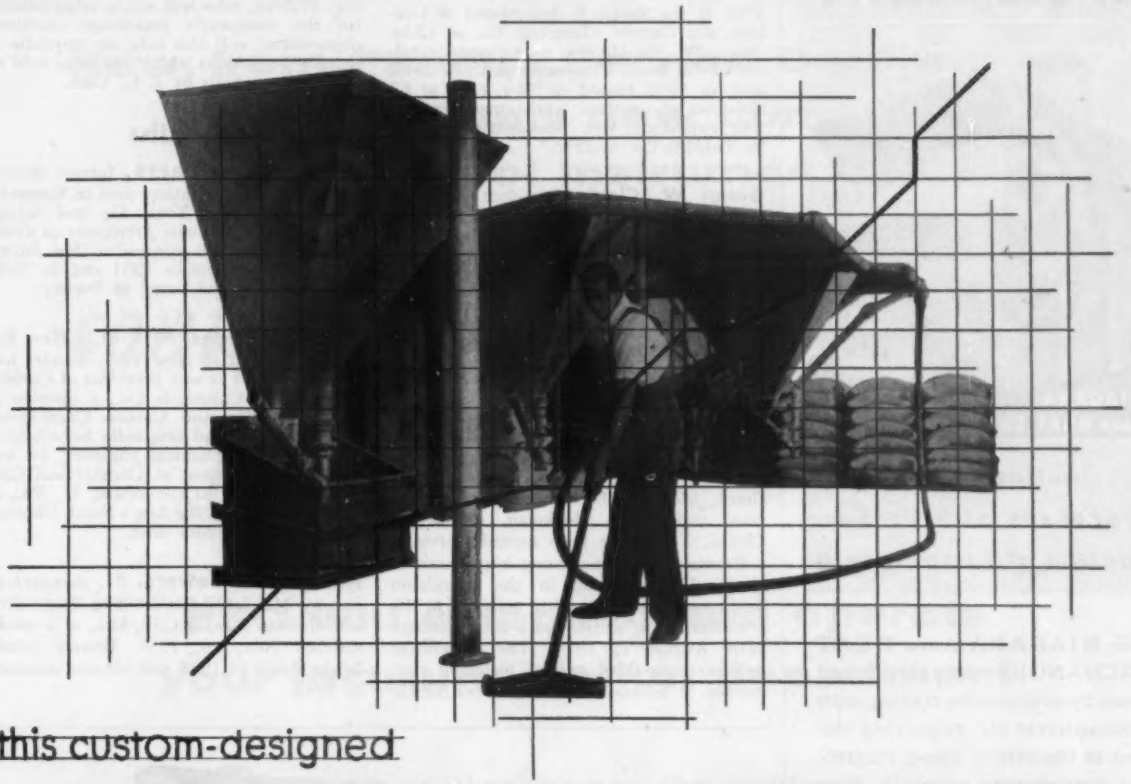

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HOFFMAN STATIONARY VACUUM CLEANING SYSTEM

aids plant cleanliness...recovers valuable product!

The Holly Sugar Corporation has always been proud of—and noted for—its "housekeeping". In its refinery at Brawley, California, three or four men were assigned to daily hand-sweeping but the management soon realized that sweeping removed only part of the dust while the remainder was moved and rescattered through the plant.

Hoffman was asked to survey the requirements; and designed a stationary vacuum cleaning system, with the following features:

1. Adequate capacity for rapid and thorough cleaning of the entire plant with sufficient inlet valves to make the work as easy as possible.
2. Convenient location of the separators so the collected material is dumped directly into "remelt" for recovery of sugar.
3. Connections for 2" vacuum hoses at points where spills had previously required laborious and costly handling.
4. Much of the dust in the plant was seeping from the housings of the bucket elevators and storage bins, so special vacuum connections, creating a slight negative pressure from the enclosures into the pneumatic system, prevented the material from escaping as dust. This was then recovered with the rest of the sugar picked up in vacuum cleaning.

As a result of the Hoffman installation, Holly Sugar now has a cleaner plant—with only two sweepers!

Let Hoffman offer recommendations for your needs, whether they are cleaning, conveying, recovery or all three. Your letter for detailed information or an engineer's survey will get prompt attention, without cost or obligation.

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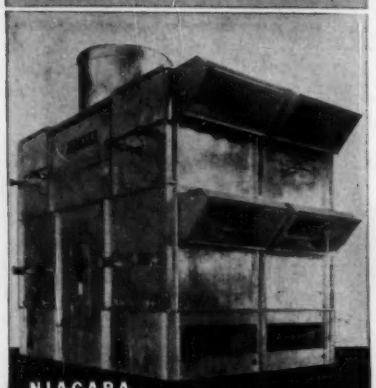

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The NIAGARA Aero HEAT EXCHANGER cools liquids and gases by evaporative cooling with atmospheric air, removing the heat at the rate of input, controlling temperature precisely. You save 95% of cost of cooling water; you make great savings in pumping, piping, power; quickly recover your installation cost.

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In CHEMICAL PROCESSES this is successfully used in cooling liquids and gases, chemical reactions, condensing distillations and reflux cooling.

Write for complete information; ask for Bulletins 120 and 124. Address Dept. P.R.

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N.Y.
District Engineers in Principal Cities of U. S. and Canada

Men in the Industry . . .

1924 in the Research department of Carbide and Carbon Chemicals Co. at Clendenin, W. Va. He was made superintendent of the South Charleston plant in 1940, and, in 1946, moved to New York to fill the post of assistant works manager. He was appointed vice president-production for Bakelite Co. in 1952.

Glenn W. Clark, president of Cities Service Gas Co., Wichita, Kan., a subsidiary of Cities Service Co., has been elected president and director of Mississippi River Fuel Corp., succeeding **William Marbury.**

R. S. Cannon, chief electrical engineer, Plantation Pipe Line Company, Atlanta, Ga., has been named chairman of the Committee on Petroleum Industry of the American Institute of Electrical Engineers. **L. E. Oberhelman,** head engineer of the Standard Oil Company of Indiana, Sugar Creek, Mo., has been named vice chairman, and **T. V. Bockman,** of Corpus Christi, Texas, has been named secretary.

Because of the increasing importance of electrical engineering in the petroleum field, committee status was assigned to the petroleum unit, which was a subcommittee until August 1, 1954. The committee sponsored its third annual technical conference in Kansas City, September 17-19.

Vernon A. Bellman, Socony Mobil Oil Co., Inc., has been elected a member of the board. He succeeds **Herbert Willetts** as director in charge of domestic marketing. Willetts, who will retain responsibility for the company's petroleum chemicals department, will also take the portfolio of employee relations which has been held on a temporary basis by **J. C. Case.**

Deaths

Arthur T. Roberts, former Socony Mobil Oil Co. executive, died in Roosevelt Hospital in New York. He had retired from Socony ten years previously as director, treasurer and controller. He started in the oil business in 1907 and in 1939, was elected to the board of Socony.

Gene B. Landes, 69, died in New Rochelle Hospital in New York. Landes had retired in 1954 as vice president of Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corporation which firm he had originally helped form in 1917. A mechanical engineer, he was plant superintendent of Carbide and Carbon's first plant at Clendenin, W. Va., in 1929, and headed the firm's South Charleston plant five years later.

Henry Kirk Bowers, 51, manager of Socony Mobil Oil Co.'s White Eagle division died in Kansas City, Mo., of a stroke suffered Nov. 20, 1956. Bowers joined White Eagle in 1928 and became manager in 1949.

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HIGH-PRESSURE
NEEDLE VALVES

Forged steel valves in ¼" – ⅜" – ½" or ¾" sizes for high-pressure throttling gauging or sampling services. The safety bonnet type meets exacting safety requirements.

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ENGINEERS . . . write for illustrated Bulletin 101.

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Now, from Panellit Service Corporation, a completely new concept in the field of instrumentation

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What Suppliers Are Doing . . .

Wicker

Gillespie

Burnett

Ball

Liechti

Arthur Craig Wicker has joined the Sales Development department of **Tube Turns**, Louisville, Ky. Wicker was born in Cincinnati. He attended Purdue University and Oregon State, and obtained his B.S. degree in chemical engineering at the University of Louisville's Speed Scientific School. He began his career with The Girdler Co.'s Votator division. Prior to joining Tube Turns in October, 1956, he was plant superintendent for the Flexible Materials division of the U. S. Plywood Corp. During World War II, Wicker was a staff sergeant of the Corps of Engineers. He is a member of the American Institute of Chemical Engineers and the Society of Plastics Engineers.

J. S. Gillespie, acting manager of the industrial diamond project for **General Electric Co.**'s Metallurgical Products department, Detroit, has been named manager of engineering. In addition to his new duties, Gillespie will continue as acting manager of the diamond project.

Gillespie joined General Electric Co. in 1936 as an engineer for the then Carboloy department. Before becoming acting manager of the diamond project, he was manager of product planning.

Previous to that he served in several of the organization's district offices, as manager of carbide tool and wear parts sales engineering, and as manager of product sales.

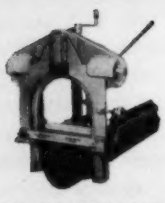
Erwin F. Burnett has been appointed manager—commercial research section of the Dallas headquarters office of **United States Steel Corp.**'s Oil Well Supply division. He succeeds Neal K. Schnaitter, who has been transferred to the United States Steel Products division of U. S. Steel as assistant to vice president-sales in the division's New York office.

Myron S. Ball has been appointed district sales manager, Atlanta, Ga., for **Blaw-Knox Co.**, Power Piping & Sprinkler division. Ball has been associated with the industrial piping industry since 1947, first as an engineer and recently as a contracting sales engineer. He graduated from Georgia Institute of Technology in 1943 with a B.S. degree in mechanical engineering, and served in the U. S. Navy as engineering and executive officer in the Pacific area from 1944 to 1946.

He is a member of the Atlanta section of The American Society of Mechanical Engineers.

Charles Liechti has been appointed chief engineer, technical services, of the **Eutectic Welding Alloys Corp.**, Flushing, N. Y. Liechti is a graduate engineer from Swiss Federal Institute of Technology in Zurich and has had many years experience in metallurgy and metal fabricating. He was

WACHS *Portable*
POWER AND MANUAL PIPE CUTTERS
2" TO 72" CAPACITY



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"The milling machine on wheels"
Cuts 10" to 72" Pipe

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MORE USES:
Neoprene's extra protection is ideal wherever surfaces must be protected against acids, caustics, solvents or constant moisture. Brush or spray.

FREE
A new booklet gives complete information on this revolutionary paint development, tells how to get best results. Write for your copy today!

THE WILBUR & WILLIAMS CO.
BOSTON (Brighton) 35, MASS.

"It's like hearing a hundred taxi meters clicking away..."

Don't sandblast—strip it! Powerful Oakite strippers, applied by hot flow-on, steam gun or cold-flow-on, safely float off paint, dirt, grease.

That's how one refinery man described his feelings about equipment downtime. And no wonder, with all those *bpd* being lost.

Oakite keeps your maintenance cleaning dollars from ticking away by holding downtime to an absolute minimum through the use of specialized materials, methods and equipment developed for the petroleum industry.

A valuable 48-page booklet "What Petroleum Men Should Know to Simplify Cleaning," explains the fast, easy Oakite way to clean towers, tanks, heat exchangers, drums, piping, tank cars, barges, salvaged equipment. Write today for a free copy. Oakite Products, Inc., 50B Rector Street, New York 6, N. Y.

Don't rod out scale—dissolve it! Oakite chemical in-place cleaning lets you open up clogged piping without rodding or drilling . . . and no dismantling.

Don't scrape and brush—Oakite steam-gun it! "Mechanized" cleaning is exemplified by heavy-duty Oakite steam-detergent guns, including the sensational new "Hurriclean" that weighs only 6¼ lbs., is always cool to the touch, handles like a dream.

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Manning & Lewis heat transfer and process equipment is designed and constructed to better *your* most exacting requirements and make it easy for you to place a safe bet on trouble-free worry-free, long term operation.

M & L meets all requirements of A.S.M.E. or any other agency specified by you, the customer. All equipment designed by M & L is sold on a guaranteed basis for your protection.

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Suppliers . . .

formerly the chief engineer of one of Socony Mobil Oil Co.'s Industrial Lubricating divisions.

In his new position, he will coordinate and supervise Eutectic's field activities and technical services both here and abroad, and further develop the educational and training programs for the firm.

Liechti has just returned from a study of Eutectic's affiliated organizations in London, Paris, Lausanne and Frankfort.

Owen Kuhen has been named product specialist for **Carrier Corp.'s** large-capacity absorption refrigeration equipment.

Kuhen is a member of the American Gas Association and the American Society of Refrigerating Engineers. He is widely known throughout the gas industry, having worked closely with gas utilities for many years. Before joining Carrier he was product director for absorption equipment with Servel, Inc., for 23 years.

Kuhen

Curley

J. R. Curley has been named sales manager for Vamistor products of **Weston Electrical Instrument Corp.**, Newark, N. J., a subsidiary of Daystrom, Inc. Curley had previously been associated with IRC for five years in marketing resistor and potentiometer products. Prior to that he was manager of the electronics products analysis section of RCA in Camden.

E. N. Hower has been appointed manager, Engineering and Construction department sales of **Dravo Corporation, Pittsburgh.**

Hower formerly was manager of the machinery division's industrial department and has been a member of the Dravo organization since 1947. A native of Philadelphia and a graduate of Lehigh University, Hower is a member of the Eastern States Blast Furnace and Coke Oven Association, Engineers Society of Western Pennsylvania, American Institute of Mining and Metallurgical Engineers, and the Iron and Steel Institute of Great Britain.

Hower

Rodgers

Clyde A. Rodgers has been appointed assistant superintendent of oxygen steelmaking production at **Kaiser Steel Corp.** In assuming his new post, Rodgers will

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These separators made by Black, Sivalls & Bryson, Inc., are used to extract liquids from air and gas lines. Removal of these liquids prevents damage to compressors and other mechanical equipment. In cold weather, they are helpful in preventing freeze-ups of gas transmission lines.

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- INJECTORS
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Suppliers . . .

be involved in bringing to the west its first oxygen steelmaking plant.

A graduate metallurgical engineer from Ohio State University, Rodgers came to Kaiser Steel in 1946 from Youngstown Sheet and Tube, Ohio, where he was metallurgical observer and practice engineer in the open hearth division for 11 years.

At Kaiser Steel he became assistant to the superintendent of the open hearths, chief observer, then product metallurgist and chief inspector for the primary rolling mills. He is an active member of the American Institute of Mine Metallurgical Engineers.

Roger Gilliland has joined **Manning, Maxwell & Moore** as sales engineer for the West Coast.

Gilliland

Gilliland, after graduating from Case Institute of Technology with a B.S. degree in electrical engineering, served as development engineer for Brush Development Corp. and in the Navy Bureau of Ordnance. He was with the Swartwout Co. for ten years as head of development of pneumatic and electronic controls and as West Coast district manager. Recently, he was an application engineer for G. M. Giannini Co.

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LIQUID GRAVITOMETER
For PIPELINES, REFINERIES, GASOLINE PLANTS
NOW 19 MODELS
MODEL R
This ruggedly built instrument of laboratory accuracy is ideal for quick checking and for continuous recording of Specific Gravity of liquids under line pressure. Changes in Specific Gravity of sample are recorded with a very minimum of time lag. Foreign liquids and gases are automatically purged from sample. No moving joints or stuffing boxes to cause friction or leakage. Temperature corrected, this precision instrument is adaptable to high pressures. Hundreds are in daily use in plants and refineries of major companies. Available in 19 Models for Recording, Signalling, Transmitting and Controlling. Send for Bulletin 111R-3.
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AVAILABLE FOR EARLY DELIVERY
SEND FOR BULLETIN No. 111-R3

Beckman Instruments, Inc., has announced that **Dr. William Shockley,** director of the Shockley semiconductor laboratory of Beckman and two other American scientists have been awarded the 1956 Nobel Prize for Physics for their development of the revolutionary transistor.

Shockley

Dr. Shockley directed the solid state physics research program at Bell Telephone Laboratories which saw the development of the first transistor by Brattain and Bardeen in 1948. In 1952, Dr. Shockley completed work on the junction transistor, the tiny replacement for vacuum tubes which introduced the benefits of miniaturization, durability, low power requirement and extremely long life to the field of electronic equipment.

Dr. Shockley joined Beckman Instruments, Inc., in September, 1955, to found a new facility for the development and application of transistors and other semiconductor devices.

Dr. Shockley's scientific achievements have been acknowledged by numerous awards in addition to the Nobel Prize. He was given the Medal for Merit by former President Harry S. Truman. In 1952, he was awarded the Maurice Liebmann Prize by the Institute of Radio Engineers.

In 1953, he received the Oliver E. Buckley Solid State Physics Prize from the American Physical Society, and in 1954, the Cyrus B. Comstock Award from the National Academy of Science. Last June he was given an honorary doctorate by Rutgers University for his contributions to science. He is the recipient of a similar degree from the University of Pennsylvania.

Evans Research and Development Corp., has appointed **Dr. Alfonso Cornejo,** Mexico City, agent in Mexico according to **Ralph L. Evans, Jr.,** vice president for foreign operations of the New York City chemical consulting laboratory.

Dr. Cornejo is a widely known consultant and professor at both the National University of Mexico and the National Polytechnic Institute of Mexico.

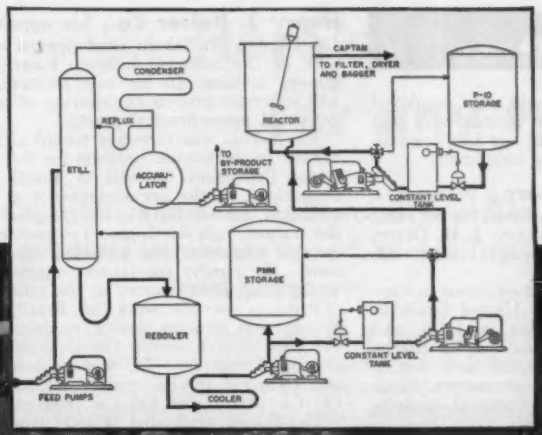
Dr. Cornejo studied at St. Mary's University (Texas), Dulwich College (England), University of London (England), University of Leipzig (Germany), and Stanford University (California). He had several years of industrial experience in the United States before settling in Mexico over twenty years ago.

Daystrom Inc., has named as a director, **Chester F. Smith,** formerly a vice president, director, and member of the executive committee of Standard Oil Company (N.J.) Smith was with New Jersey Standard for 43 years.

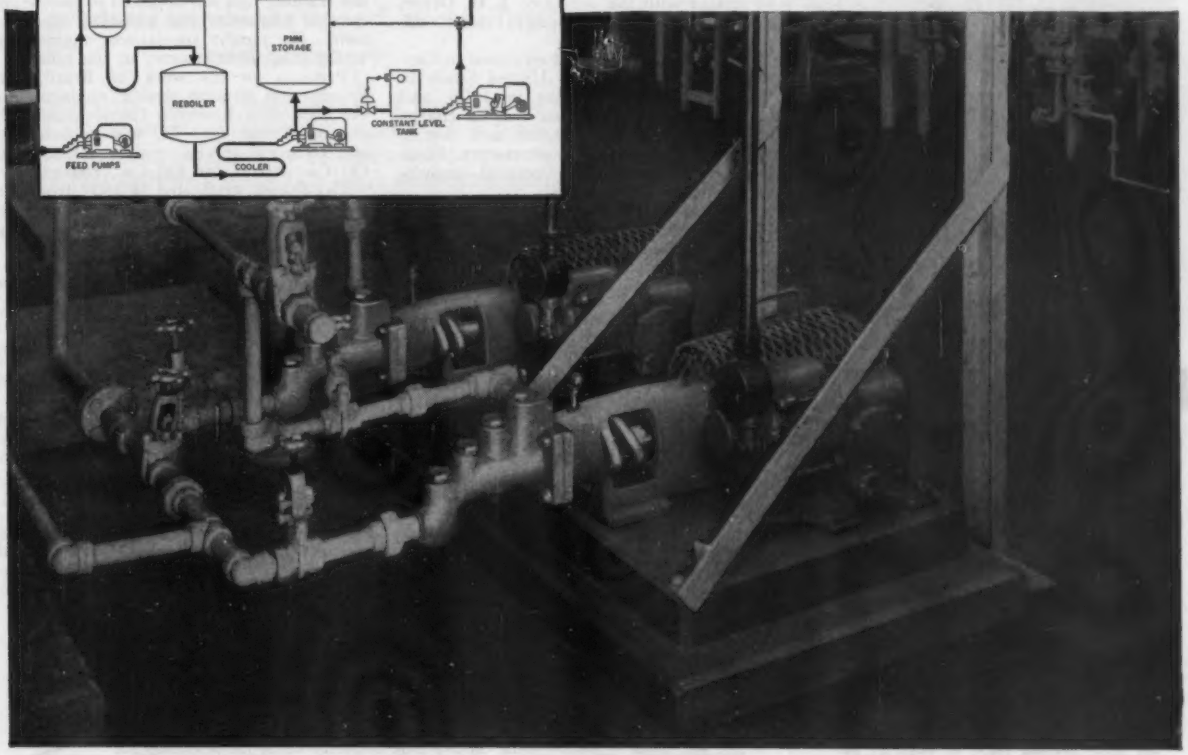
Smith was a recipient of the Certificate of Appreciation of the American Petroleum Institute and a Knight of the French Legion of Honor and Belgian Order of Leopold.

United States Steel Corp. has announced the employment of **Aubra P. Wells** as manager of the Farmington, N. M. store of U. S. Steel's oil well supply division. Wells attended Louisiana State

For more data on advertised products, use Readers' Service Cards, last page.



In the production of Captan, an agricultural fungicide, Milton Roy pumps control feed rates in the separation of perchloromethylmercaptan by distillation at Calhio Chemicals, Inc., Perry, Ohio. The accurate delivery of these pumps also permits reacting of chemicals in stoichiometric amounts.



Controlled Volume Pumps hold critical material balances

Provide precise control of distillation columns

You can step up the efficiency of complex distillation processes with Milton Roy Controlled Volume Pumps. These pumps make possible extremely close control of chemical feed rates and rates at which distillates are withdrawn from the still. With precise control of feed and distillate rates comes the fine balance of chemical materials which is essential to ultimate product quality.

Accurate in delivery within ± 1%, Milton Roy Controlled Volume Pumps serve equally well as flow controllers, ratio controllers, or final control elements. They're available in simplex, duplex, and multiple liquid end types. Capacities from 3 milliliters per hour to 45 gpm. Pressures to 50,000 psi.

Why not investigate these pumps for chemical metering in your own plant? Upgraded product quality, reduced chemical costs, savings in operating and maintenance expense are certain results. Milton Roy Company, Manufacturing Engineers, 1300 East Mermaid Lane, Philadelphia 18, Pa.

Write today for application data on Controlled Volume Pumps in Process Instrumentation (Bulletin 1253).

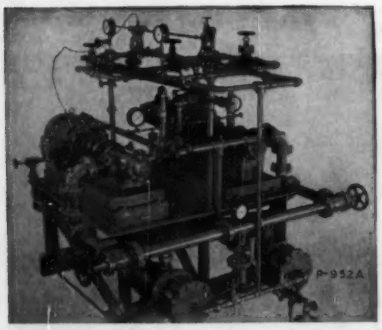
milton Roy
CONTROLLED VOLUME PUMPS

Engineering representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

For more data on advertised products, use Readers' Service Cards, last page.

COMPLETE RANGE OF SIZES AND MODELS IN BOTH MEDIUM AND HIGH PRESSURE TYPES

MORE COMPACT THAN EVER . . .



P-952-A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

NATIONAL AIROIL

FUEL OIL PUMPING AND HEATING UNITS

NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40—very interesting and informative.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1254 East Sedgley Avenue, Philadelphia 34, Pa.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas

Suppliers . . .

University. He previously was employed from 1944 to 1948 in various sales and managerial positions. He has had approximately 10 years of sales experience.

Wagner Electric Corp., presented a gold watch to **Hans Weichsel** for 50 years of service with the company. **J. H. Devor,** president of the company, made the presentation.

Weichsel was born and educated in Germany, and came to the United States in 1904. He joined Wagner in 1906, and for the next twenty years was in charge of the design, development and testing of electric motors and generators. Since 1927 he has served as electrical consulting engineer for Wagner.

Weichsel is the author of numerous technical papers which have been published here and abroad, and has lectured extensively in the United States and Canada.

Kaiser Steel Corp., has appointed **A. L. Peake** assistant manager of its central district sales office in Okland, Calif. He succeeds **Mark Anthony,** recently named assistant to the vice president and general manager of Kaiser Steel.

Prior to his appointment, Peake was assistant manager in the company's southern district sales office in Los Angeles. He joined the sales department of Kaiser Steel at the Oakland office in 1948. He was named assistant manager, rolled steel products in 1952, and moved to the Los Angeles position in 1954.

Henry J. Kaiser Co., has appointed **Dr. George M. Fekula** chief process engineer of the refinery division, Kaiser engineers division. In his new position, he will supervise process engineering of refineries and petrochemical plants.

Dr. Fekula was formerly technical consultant on petroleum projects for the National Petroleum Council in Brazil and cooperated in the organization of a new graduate school in Rio de Janeiro for the training and development of petroleum refining engineers and technical management. He taught specialized engineering and management courses in the school.

Previous to his work in Brazil, Dr. Fekula was process design engineer for the California Research Corporation and, during World War II, was technologist and technical service engineer with Shell Oil Co. and Union Oil Co., respectively.

Dr. Fekula graduated in 1937 from the University of Pennsylvania, and obtained his Ph.D. degree in chemical engineering at the University of Michigan in 1942.

Delta Tank Manufacturing Co., has appointed **W. R. Roberts** as sales engineer, oilfield equipment division. Roberts has been assigned to Delta's Lafayette, La., staff. He previously served with other equipment fabricators in Lafayette and New Orleans.

A member of the American Petroleum Institute and American Society of Mechanical Engineers, Roberts holds an engineering degree from Duke University.

Wolverine Tube has promoted **Rod T. Davies** to the newly established post of manager of aluminum sales. Davies joined Wolverine in 1954 and has served as alu-

for Throttling Service

12" heavy duty butterfly valve for throttling hot recycle gas at 265 psi; cast steel body, stainless steel disc and shaft; heat radiating fins; operated by air actuator and valve positioner, with declutching mechanism and handwheel for emergency manual control.

This is but one of many W. S. Rockwell standard and special flanged butterfly and wafer butterfly valves that meet any condition of pressure, temperature, corrosion or abrasion. Made in sizes from 4" to 144" of any metal, rubber-covered synthetic resin or glass-coated metal. For regulating, throttling or shut-off of air, gases, liquids or solids, no matter how "tough" the operating conditions. Minimum pressure drop. Non-clogging. self-cleaning. Furnished with any manual or automatic operators. Write for Catalog.

W. S. ROCKWELL
Butterfly Valves

W. S. ROCKWELL COMPANY — 2367 Eliot Street, Fairfield, Connecticut
BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES

Here's your "Task Force" for any type of fire

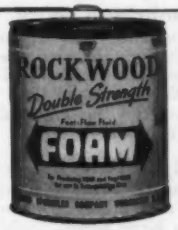
Complete team of Rockwood portable products combines speed, versatility and economy

Separately, each of these Rockwood products has its own particular advantages for fighting various types of fires. Together, they make a mobile, multi-purpose task force that delivers a whale of a lot of protection against *any* type of fire, whether it's Class A (wood, paper, rags, etc.), or Class B (flammable liquids). That includes personnel protection, too, because safety for the men who use them is an essential factor in all Rockwood fire fighting products.

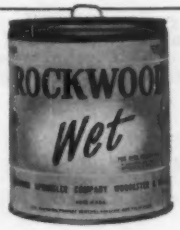
Rockwood's long, practical experience and constant research bring you not only new *efficiency* but new *economy* in fire-fighting methods and equipment. It will pay you to learn more about these and many other Rockwood products. Mail the coupon today for complete information on Rockwood's specialized fire-fighting products.

*** Type SG-60 Nozzle.** A true all-purpose nozzle that fights fire 5 ways. It discharges high velocity WaterFOG, low velocity WaterFOG (with applicator), FogFOAM, solid stream of water or solid stream of FOAM.

FOAM and "Wet" Eductor with the new FW Metering-Check Valve. Introduces Rockwood FOAM or "Wet" into hose lines, automatically proportioning correct amount of FOAM and "Wet" to water. Also usable wherever one liquid is fed into another on a fixed percentage basis.

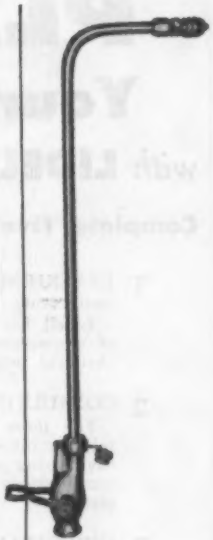


*** Rockwood Double Strength FOAM.** Puts out fires in flammable liquids, and in ordinary combustibles, quicker, at lower cost. Three parts FOAM and 97 parts water create a tremendous heat-resistant blanket. Flows freely at —15°F.



*** Rockwood WET.** One part WET mixed with 99 parts water increases water's penetration and extinguishing action. Gives quickest results against deep seated fires. Saves time, water, manpower.

Bayonet Piercing Applicator. Has a hardened steel cutting tool attached to tip, enabling operator to pierce through partitions, into interiors, etc. Discharges low velocity WaterFOG or FogFOAM.



*** Long Extension Applicator.** Discharges low velocity WaterFOG in an umbrella pattern, smothering fire without causing turbulence to flammables. Excellent personnel protection is another advantage.

FF Extension Unit. Shown with Type SG-60 Nozzle. Discharges Rockwood FOAM in a solid stream or as FogFOAM. Wide angle makes it possible to cover large areas at one time.

**NOTE: The products shown here have all been Tested and Listed by Underwriters' Laboratories, Inc.*

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

ROCKWOOD SPRINKLER COMPANY
Portable Fire Protection Division
1608 Harlow Street
Worcester 5, Mass.

Please send me your illustrated booklet on Rockwood fire-fighting products.

Name_____
Title_____
Company_____
Street_____
City_____
Zone_____ State_____

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

minum sales representative until his recent appointment. He will coordinate sales activities for both aluminum tube and extruded shapes, and headquarter at Wolverine's general sales offices in Detroit.

The Timken Roller Bearing Company has appointed the **Vanadium-Alloys Steel Canada, Ltd.**, as a distributor of Graph-Mo tool steels and Graph-Mo Hollow Bar with exclusive sales rights in Canada. The Canadian firm is a subsidiary of the Vanadium-Alloys Steel Co. of Latrobe, Pa.

Connecticut Filter Corp., a division of Cuno Engineering Corporation, Meriden, Conn., has appointed **John E. McKay** regional manager of distributor sales. McKay was previously with Henry G. Thompson & Sons Co., New Haven, where he was active in sales through industrial distributors. In his new job, he will have responsibility for sales of Cuno filters and cartridges through distributors.

Cuno Engineering Corp., Meriden, Conn. has announced the appointment of two new sales representatives for the Indiana and Ohio area. They are **John R. Carlson Co.**, and **E. C. George Co.**

The E. C. George Co. will distribute Cuno filters in the Dayton, Columbus and Springfield, Ohio area, and Carlson Co. will handle them in Indianapolis.

PLAN
Your Plants Future
with **LIDELL** *Engineering*

Complete Five Point Service

1 EXPERIENCE in all phases of chemical, petrochemical and refining engineering.

Lidell has a large staff of engineers with experience in all phases of engineering. Only Lidell can offer such complete service to the chemical, petrochemical and refining industries.

2 CONSULTING

For those problems beyond your own engineering staff, you can rely on the experienced Lidell engineers to solve every phase of new engineering projects and developments. Let us show you our particular qualifications to assist you in the development of new ideas and future plans.

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Good drawings are essential to your future plans. Lidell layouts, designs and details are neat, accurate and easy to read, and because they are, they speed up estimating, construction or remodeling.

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Our process engineering group, through continuing interest and study, is always abreast of the latest developments and new processes, and of the improvements of existing techniques.

5 EVALUATION SURVEYS

For your preliminary planning, Lidell will prepare detailed reports giving preliminary plans, economic surveys and estimates of engineering and design requirements. Lidell reports are prepared by experts to assure sound and accurate financial evaluation.

Let **LIDELL** Put A Future In Your Plant

There are many ways that we can be of service to you. On large jobs or small jobs we can save you money, because we give 100% cooperation for your needs and problems.

In doing business with us you will find a new pleasure and satisfaction.

Call or write:

LIDELL ENGINEERING SERVICES

MI 9-5842 • 100 Linden Place • Houston 17, Texas

Dykman

Boutros

Mixing Equipment Co. has advanced **Richard D. Boutros** from chief engineer to vice-president and director of engineering. Boutros has served as chief engineer since January, 1949. He joined the engineering staff of Mixing Equipment Co. in January, **1946,** following wartime service as a lieutenant in the U. S. Navy. He is a mechanical engineering graduate of the University of Virginia.

Shufelt

It was also announced that **Milton Dykman** has been promoted to chief engineer after serving as assistant chief engineer since October, 1951. Dykman is a mechanical engineering graduate of Louisiana State University.

Howard C. Shufelt becomes assistant to the chief engineer. Shufelt, who has been with the company since February, 1955, is a graduate, in mechanical engineering, of the University of Rochester.

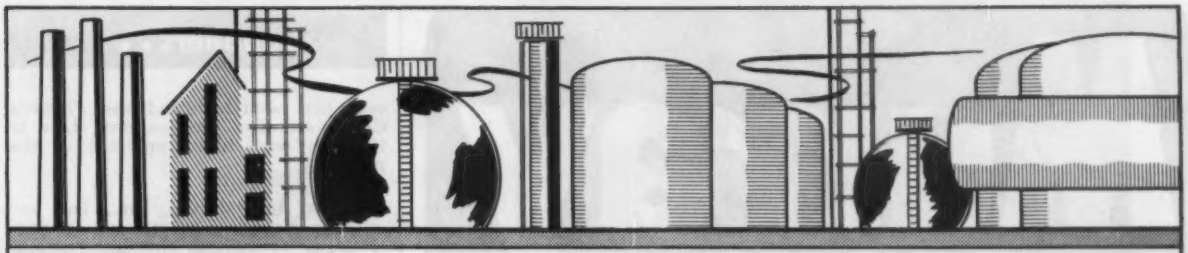
The Cambridge Wire Cloth Co., Cambridge, Md., has appointed **George Stout** as junior sales engineer in the Midwestern territory. Stout will work under **Howard E. Cloycombe** from the territory headquarters on the sale and servicing of Cambridge products.

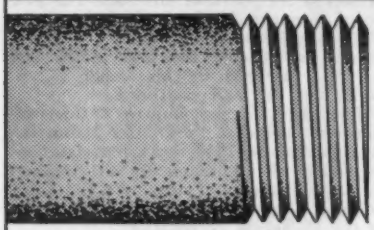
General Electric Co. has appointed **John Cuturilo** to the welding unit of the materials and processes laboratory of the company's large Steam Turbine-Generator department. Cuturilo will carry out applied research and development in the fields of arc and gas welding.

Crane Co. has announced that **Frank F. Elliott** has been designated chairman of the board of directors, and will be succeeded as president of the company by **Neele E. Stearns,** currently vice president for planning and development of the Inland Steel Co.

Elliott, whose career covers a span of 34 years, has been president of Crane Co. since June 1, 1955. He joined the organization in 1922 at the Los Angeles branch and in 1928 was named sales manager at that location. After filling a similar post at San Francisco, he served as assistant manager and branch manager, then in 1943 was named western district manager. He moved to Chicago as vice president in 1951 and became senior vice president of sales in 1952.

Stearns has been with Inland Steel Co. since 1940, when he joined the organization as manager of the department of business procedures. In 1947 he was made assistant general manager of sales, and two





DO HIGH TEMPERATURE THREADED CONNECTIONS GIVE YOU TROUBLE?

MOLYKOTE® Type G Lubricant Offers Nearly 100% Safety Against Galling and Seizing

The annual cost of repairs due to galling and seizing of high temperature threaded connections runs into fantastic figures. One oil refinery estimates a yearly expenditure of $60,000 due to this cause. Many of the top refineries are presently using MOLYKOTE, Type G, to practically eliminate these problems.

In test after test, MOLYKOTE has shown the best qualifications as a thread lubricant because it combines these important characteristics:

1. Make-up and break-away torque amazingly reduced.
2. MOLYKOTE, Type G, suitable for high or low temperature threaded connections on bearing surfaces.
3. Galling and seizing practically eliminated.
4. Excellent chemical stability. Resists all but a few strong and concentrated acids.

Here are other successful uses of MOLYKOTE Lubricants in the field!

- Excellent results obtained from the use of MOLYKOTE, Type U, in the lubrication of large Ingersoll transfer pumps on chemical marine tankers. Packing glands and shafts are lubricated. Materials pumped include molten sulfur and various petroleum solvents.
- "We use MOLYKOTE, Type G, on all threaded connections, hot and cold; also, on taper and press fits . . ."
- "We are using MOLYKOTE, Type Z, on threads of oxygen and acetylene reducing valves and on lead screws."
- "After a thorough cleaning and drying, we apply MOLYKOTE, Type Z, powder on oxygen valves and threaded connections. Results are excellent."

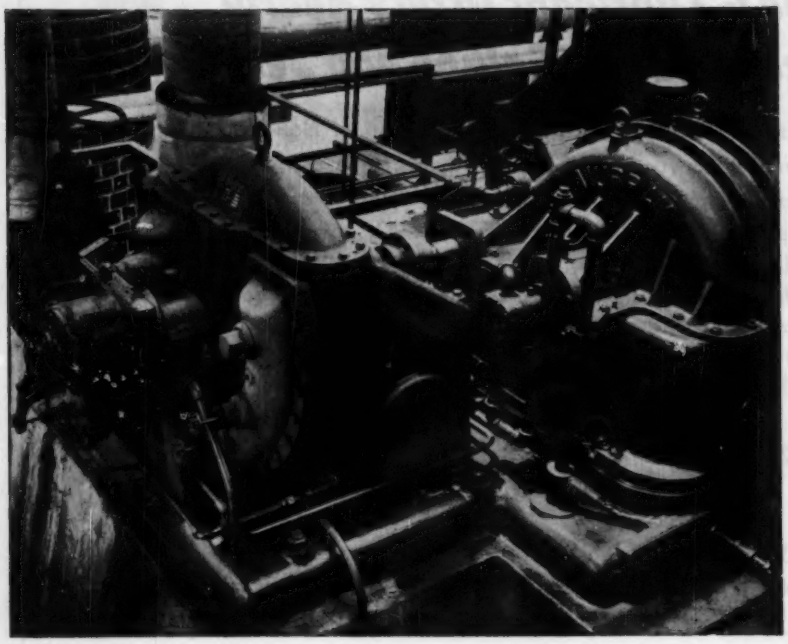
756

Send today for Lubrication Newsletter #2.

The ALPHA MOLYKOTE Corporation

Main Factories: 65 Harvard Avenue, Stamford, Connecticut
71 Arnulfstrasse, Munich 19, Germany

Murray Turbines



One of 4 Murray type U turbo-gear units installed in a southwest rubber plant still giving trouble free service after 12 years in an unprotected outdoor location. This unit drives an Induced Draft Fan requiring 425 HP at 683 RPM. The turbine speed is 3500 RPM.

● Murray turbo-gear units for mechanical drive are right at home in difficult outdoor installations. Fans, pumps, compressors, and many special types of slow speed machines are among the long list of installations powered by Murray turbo-gear units.

Murray gears are of the Herringbone or Double Helical type and all are pressure lubricated at the point of tooth contact.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

Suppliers . . .

years later went to Inland Steel Products Co. as executive vice president. Late in 1950 he was elected president of the subsidiary.

Dresser Industries, Inc., has announced the election of **Gordon G. Guiberson** to the board of directors. The new board member is the president of the Guiberson Corp., Dallas. Since 1951, Guiberson has headed the firm which was founded in 1919 by his father, S. A. Guiberson, Jr., and two brothers.

The assets of the Guiberson Corporation were acquired by Dresser Industries, Inc., in August, 1956, for a reported consideration of approximately $10 million in Dresser common stock. At the time, Guiberson agreed to remain as president of the Guiberson corporation.

Allis Chalmers Manufacturing Co., has named **Charles F. O'Riordan** manager of the midwest region. He succeeds **J. F. Burrus,** recently named an assistant general manager in the firm's power equipment division.

O'Riordan joined Allis-Chalmers in 1935 after receiving his electrical engineering degree from Virginia Military Institute. He was assigned to the Atlanta district in 1938 and in recent years had been manager there.

Joseph M. Duncan, a sales representative in the New Orleans district since 1951, succeeds O'Riordan as manager at Atlanta. Duncan is a 1949 graduate electrical engineer of Duke University.

Borg-Warner Corp. has elected **Henry M. Haase** as vice president in charge of engineering and research. Haase came to Borg-Warner in January, 1955 as assistant to the president.

In his new capacity Haase will direct the corporation's expanding program of produet planning and engineering research and development, including general supervision over the newly built Borg-Warner Research Center in Des Plaines, Ill. and the Petro-Mechanics Research division in Los Angeles.

United States Steel Corp. has announced the employment of **William H. Ravert** as field representative at the Fort Morgan, Colo. store of U. S. Steel's Oil Well Supply division. Ravert received his B.S. degree from Chadron State Teachers College, Chadron, Neb. An army veteran of World War II, he had four years oil field supply experience before joining "Oilwell."

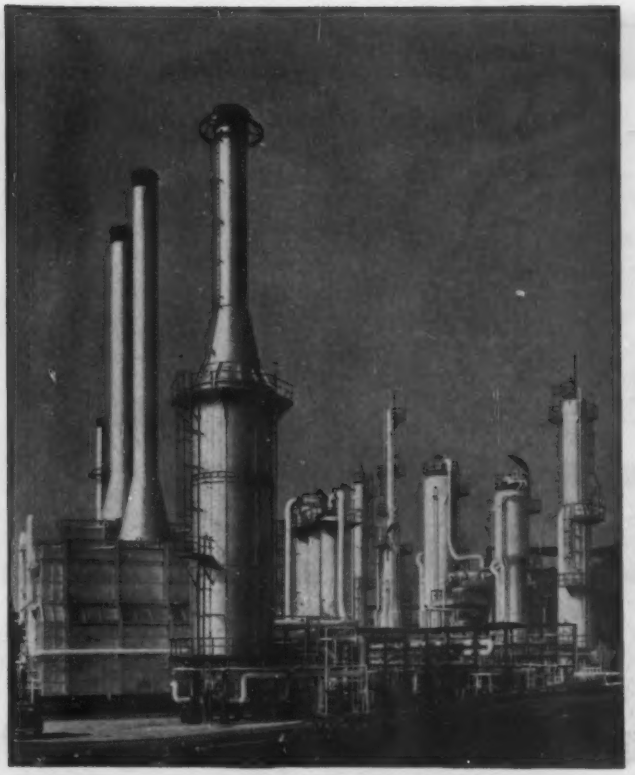
E. I. du Pont de Nemours and Co. Inc., has announced the appointment of two assistant general managers, **Dr. William C. Kay** for the organic chemicals department and **Ernest R. Bridgwater** for the newly created elastomer chemicals department.

Dr. Kay, director of manufacture of the organic chemicals department, succeeds **Dr. George E. Holbrook** who was named general manager of the new elastomer chemicals department. Bridgwater has headed sales activities of the rubber chemicals division, later the elastomers division, since 1929.

Dr. Kay, a native of Melrose, Minn., graduated from the University of Minne-

For more data on advertised products, use Readers' Service Cards, last page.

INTERESTED IN UNIFINING* FOR DESULFURIZATION AND UPGRADING



• Unifining Unit
Union Oil Company of California refinery
Oleum, California

UNIFINING should be of particular interest to all operators of catalytic reformers which produce by-product hydrogen.

• Harshaw is the exclusive producer of the Union Oil Company of California cobalt-molybdate catalyst used in the recently announced "Unifining" desulfurization and upgrading process. This rugged, commercially proven catalyst is supplied in the form of cylindrical tablets conforming to rigid physical and chemical specifications established by Harshaw and Union Oil Company of California. Stability at high temperatures permits repeated regenerations if and when necessary.

Please contact Harshaw for further information on this catalyst.

HARSHAW

THE HARSHAW CHEMICAL CO.

1945 East 97th Street, Cleveland 6, Ohio

Chicago 32, Illinois • Cincinnati 13, Ohio • Detroit 28, Michigan • Hastings-On-Hudson 6, N. Y.
Houston 11, Texas • Los Angeles 22, California • Philadelphia 48, Pennsylvania
Pittsburgh 22, Pennsylvania

* Trademark of Union Oil Company of California

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Suppliers . . .

sota in 1930. Upon obtaining his doctor's degree in science from Massachusetts Institute of Technology, he joined du Pont's engineering department in 1934 as an industrial engineer at the company's Chambers Works, Deepwater Point, N. J.

Bridgwater studied at the University of Akron and graduated from M.I.T. with a B.S. degree in 1918. Following his discharge from the chemical warfare service at the end of World War I, he was employed as a rubber chemist by the B. F. Goodrich Co. for three years and by the Firestone Tire and Rubber Co. for two years prior to joining Du Pont in 1924.

Brown Fintube Co., Elyria, Ohio, has announced the formation of a subsidiary to be known as **The Brown Thermal Development Co.**

The new company will develop, design, manufacture and sell heat transfer equipment for waste heat recovery, recuperation, and air and gas heating by direct fire. The fired heater division of the Brown Fintube Co., will be incorporated within The Brown Thermal Development Co.

The officers of the new company are: **John W. Brown, Jr.,** president; **Arvid C. K. Nihlen,** vice president; **Carroll M. Tate,** vice president, sales; **Howard A. Niederst,** treasurer; **Robert E. Preston,** chief engineer; and **Thomas P. Kroehle,** chief sales engineer.

Wolverine Tube has appointed **C. A. Johnson** as sales representative in the Detroit area. He will replace **Robert C. Crowe** who has moved up to manager of industrial sales.

Johnson has served on various capacities within the Wolverine's general sales offices, for several years, and will now headquarter in the East Central district offices.

United States Steel Corp. has announced the transfer of **Kennon W. Chambers,** field representative at Shreveport, La. for its Oil Well Supply division, to Kilgor, Texas. Chambers was employed by "Oilwell" in 1952 at Greggton, Texas. During World War II he served in the U. S. Air Force. A native of Texas, he attended Southern Methodist University, Dallas, Texas.

Jones & Laughlin Supply Division has announced three recent personnel assignments. **Charles P. Hudson,** a J&L sales representative formerly located at Lake Charles, La., has been transferred to the firm's South Texas district with headquarters in Houston. **Bobbie W. Ramsey** formerly a storeman at Victoria, Texas, and **James R. Kilmer,** formerly manager of J&L's supply store at Clay City, Ill., have been promoted to sales representatives in the Louisiana Gulf Coast, and the Illinois-Kentucky districts, respectively. Ramsey will concentrate his sales activities in the Lake Charles area, and Kilmer will operate out of the firm's Carmi, Ill. store point.

De Laval Steam Turbine Co., has named **Cia. Wilbur-Ellis Peruana, S. A.,** Lima, Peru, exclusive Peruvian sales representative according to an announcement by **Sherry W. Johns,** export sales manager. Cia. Wilbur-Ellis also represents Bethlehem Steel Co., Chrysler Corp. (Marine Division), and Harnischfeger Corp., among others.

Allen B. DuMont Laboratories, Inc., has appointed **Neil Uptegrove** advertising manager of the technical products division. Uptegrove will also be responsible for advertising and sales promotion of the company's industrial tube products.

Immediately prior to his promotion, Uptegrove served the company as advertising manager for Du Mont instruments. He had held that post since 1953. He joined the company in 1948 as an advertising copywriter after two years service with the editorial staff of *Scientific American* Magazine.

Allis-Chalmers Industries has named **O. V. Tally** manager of the firm's Washington district. In his new capacity, Tally will be in charge of all Washington operations for the company's industries and tractor groups.

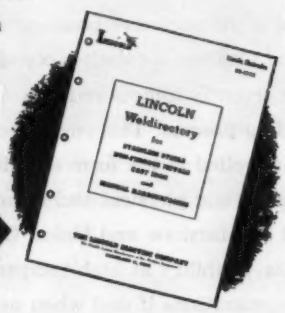
Tally joined Allis-Chalmers in 1926 as a representative in the New York, Washington and Philadelphia districts. In 1943 he was named manager of the St. Louis district. In 1950 he became manager of the Midwest region and in 1954 director of industrial sales of the industries group. He is an electrical engineering graduate of North Carolina College of Agriculture and Engineering.

R. N. Landreth, who has been manager of the Washington district since 1950, has been assigned to the industries group sales staff. Landreth is a graduate of

STAINWELD
by Lincoln
Now the easiest operating electrode for welding 18-8 stainless—*Try it*

For quality, for speed, there's no equal to Lincoln Stainweld A7 and A7-Cb. It has smooth operating characteristics in all positions without slag interference. Has easy slag removal. Low in price. Available in standard steel container or hermetically sealed container.

Stainweld A7 and A7-Cb operate on AC and DC for welding 18-8 stainless. Other electrodes are available for 25-12 Stainless, 18-12 Stainless and 25-20 Stainless.

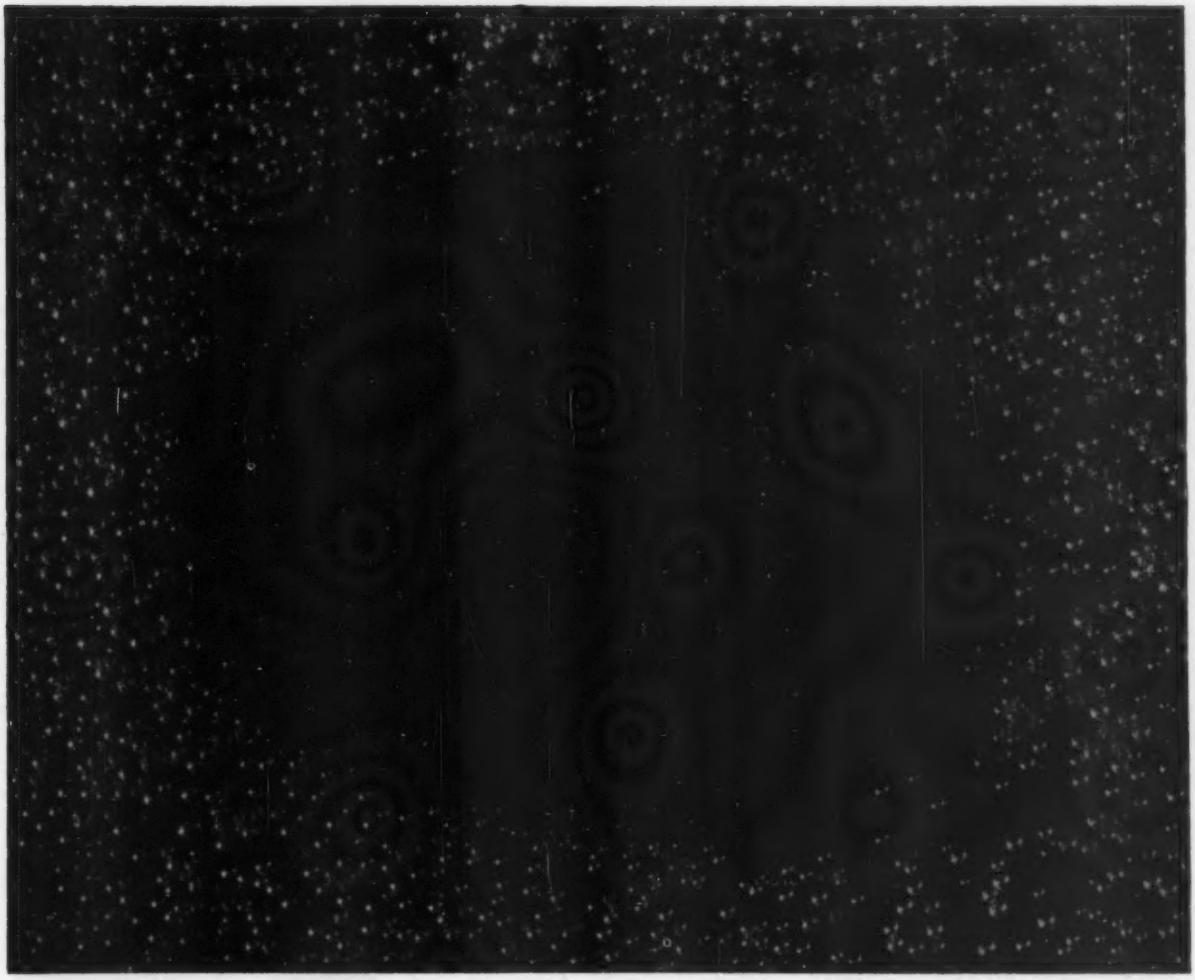


Write for specifications and procedures in Lincoln Weldirectory SB-1352.

THE LINCOLN ELECTRIC COMPANY
Dept. 2206 • Cleveland 17, Ohio
The World's Largest Manufacturer of Arc Welding Equipment

When Stainweld electrodes **Have** peak dependability **Yet** save you money **WHY** use anything but LINCOLN for stainless

For more data on advertised products, use Readers' Service Cards, last page.



An Inside-Out View

CORROSION INHIBITOR AT WORK

Here's an external view of what takes place internally in refinery equipment. This photograph shows a piece of mild steel. The center has been treated with Polyrad. The entire piece of steel then was immersed in an acidic environment. The tiny bubbles of hydrogen show the beginning of corrosion. But the center portion remains a safety island—thanks to Polyrad.

This photographic impression bears out what most refinery operators already know—that Polyrad is an effective inhibitor. It will economically reduce corrosive damage with an average treatment of about 1 quart of Polyrad per 1,000 barrels of fluid.

Polyrad's powerful detergent action also serves to loosen organic and inorganic deposits, allowing them to be removed in the fluid stream.

All around the refinery, Polyrad can help maintain throughput, increase heat transfer, reduce metal loss, and cut down-time for maintenance. A Hercules technical representative will be glad to explain how Polyrad can be used to combat your specific corrosion problem.

Pine Chemicals Division, Naval Stores Department

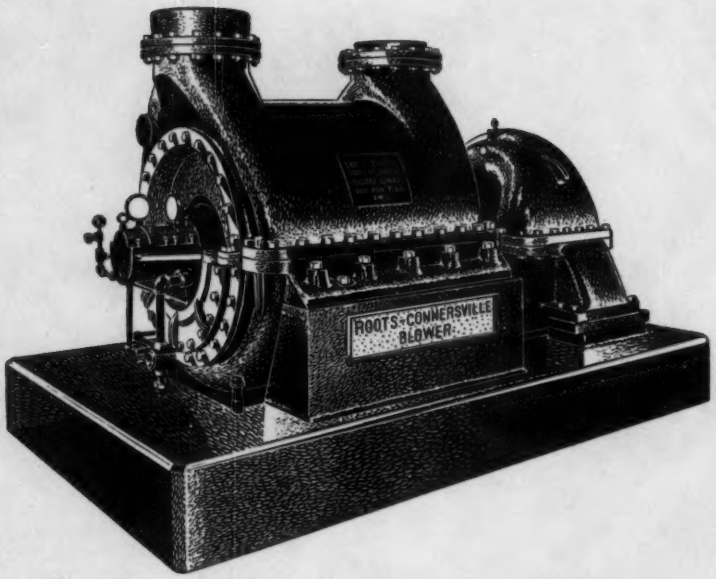
HERCULES POWDER COMPANY

INCORPORATED

976 Market St., Wilmington 99, Del.

POLYRAD®

FILMING AMINE INHIBITOR



R-C centrifugal blowers assure accurate control of volume and pressure

At any speed, Roots-Connersville centrifugal blowers assure uniform delivery of air or gas without the use of receivers. In matching supply to changing demand, this inherent operating advantage simplifies accurate and instantaneous control of volume and pressure.

R-C centrifugals may be direct-connected to high speed electric motors or turbines. Operating speeds may be further raised with speed increasing gears. Occupying a minimum of space and perfectly balanced, with semi-rigid bearing supports to dampen vibration, they do not require special, costly foundations.

Liberal design of diffuser and return passages results in low velocities, normal efficiency even when build-up occurs and exceptionally quiet operation. Operating without internal lubrication, oil-free air is discharged, making it ideally suited for exacting process applications. For complete specification details, write for Bulletin 120-B-14.

Engineers—unusual career opportunities await you at Roots-Connersville. Address your resume to Professional Employment Manager.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

157 Crescent Ave., Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto, Ont.

Suppliers . . .

Union College and did post graduate work at Massachusetts Institute of Technology and New York University.

Hewitt-Robins, Inc., has appointed **Harry G. Knechtel** manager of sales operations of the Hewitt Rubber Division, Buffalo, N. Y. He succeeds **Charles W. Mackett** who will retire next year.

Knechtel joined Hewitt-Robins in 1940 as a trainee in the Buffalo plant. In 1952 he was named assistant manager of hose sales and in 1953 was appointed manager of hose sales and development, the position he held at the time of his new appointment.

Named to succeed Knechtel is **Richard A. Gifford.** Gifford joined Hewitt-Robins in 1946 as a member of the hose sales and development department, Buffalo. He was transferred to the Charleston district office in 1950 and has served since then as a field engineer in that area.

Walworth Co. has appointed **Howard A. Reid** executive assistant to the vice president in charge of sales. Reid will coordinate advertising, market research, sales training, sales promotion and public relations for Walworth. He formerly directed advertising and sales promotion for American Machine & Foundry Co.

Laclede-Christy Co., Division, H. K. Porter Co., Inc., has appointed **Philip G. Monteith** as assistant to the sales manager.

Monteith is a ceramic engineer, previously employed by Chicago Vitreous Corp. in its laboratory, customer service section, and development section. Subsequently, he was process engineer, supervisor of quality control, process control, and process engineer.

Wolverine Tube has promoted **Jack Sheehan** to manager of wholesale sales. He will replace **A. S. Kingerley** who has been appointed assistant district sales manager of Wolverine's East-Central district. Sheehan was formerly sales representative in the Louisville, Kentucky, area of Wolverine's East-Central district.

Pressed Steel Tank Co., Milwaukee, recently announced that **Robert P. Ricker** has been named manager of the company's New York office, and that **James A. Varnado** has been transferred to the Downingtown, Pa., office.

Ricker joined Pressed Steel Tank Co. in 1951, and was district manager of the Minneapolis territory until he was transferred to Downingtown in 1955. Varnado, who now replaces Ricker at Downingtown, was manager of the Kansas City district.

The National Supply Co., has appointed two assistant directors in its research and engineering department. The positions were created to strengthen the company's program of developing new and improved products.

Herbert L. Willke has been named assistant director, engineering and **Peter Tauson** assistant director—research. The men will serve in Pittsburgh under **Joseph R. Mahan,** director of research and engineering.

Willke joined the company in 1930 as a field engineer at Houston. He was transferred to the Toledo, Ohio, plant in 1934

BRIEFS
for caustic soda buyers

New booklet
Barge delivery
Flake sizes
New drum

Useful facts on buying caustic soda are at your fingertips in this new pocket-size booklet.

Title: *Caustic Soda Buyer's Guide.*

Contents include a list of reasons *pro* and *con* switching from 50% to 73% liquid caustic.

There's a factual discussion of the comparative economics of both strengths, including a handy nomograph to help you figure which strength is your better buy.

The booklet also contains a nomograph that helps you estimate your liquid caustic requirements for various process solutions.

There's information on solid and flake caustic, too. Two tables show at a glance the dimensions and capacities of the many containers in which you can buy Hooker caustic soda.

Finally, there's a list of important points to consider when you're looking for a caustic soda supplier.

Check the coupon at right for a copy. Or write us if you'd like more than one.

Can you save buying by barge?

If you use large tonnages of 50% liquid caustic soda, and can receive by

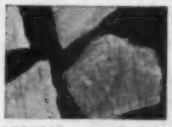
water, you may cut freight and handling costs substantially with barge service.

All Hooker plants and caustic terminals offer barge service as well as tank car service, since all are located on deep water.

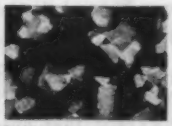
If you think there's a possible saving here, one of our representatives will be glad to discuss barge delivery with you.

Which flake size? It's easy to be sure of the best possible caustic soda flake size for your process, when you buy Hooker caustic.

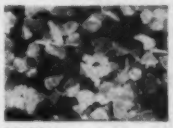
You have your choice of the four sizes here—all shown actual size.



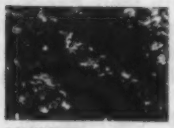
REGULAR



FINE



CRYSTAL



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Regular, fine, and *crystal* flake are non-dusting—carefully screened for uniformity. We're extra-fussy about flake *thickness,* too. These flakes are hefty enough to take the jolts and jouncing of transit, and still reach you at full size. Yet they're thin enough to dissolve quickly when you're ready to put them to work.

For advice on the best flake size for your needs, write us, outlining the intended use.

New caustic soda drum empties faster. Whether your men scoop, pour, or shovel flake caustic soda, they'll find our new drums faster, easier, and safer to work with.

The new drum has a 65% larger opening area than the old style.

You pay no extra for this new drum. So, if you've been paying a premium to get caustic soda in full open-head drums, you can now get many of the advantages of a larger opening at standard prices.

Check items you'd like to receive:

- ☐ *Caustic Soda Buyer's Guide* Technical data on:
- ☐ 50% Liquid Caustic Soda
- ☐ 73% Liquid Caustic Soda
- ☐ Flake Caustic Soda

For information on these other Hooker chemicals used in the petroleum industry, check below:

- ☐ Aluminum Chloride, anhydrous
- ☐ Antimony Trichloride
- ☐ Muriatic Acid
- ☐ Sulfur Monochloride
- ☐ Sulfur Dichloride

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HOOKER ELECTROCHEMICAL COMPANY

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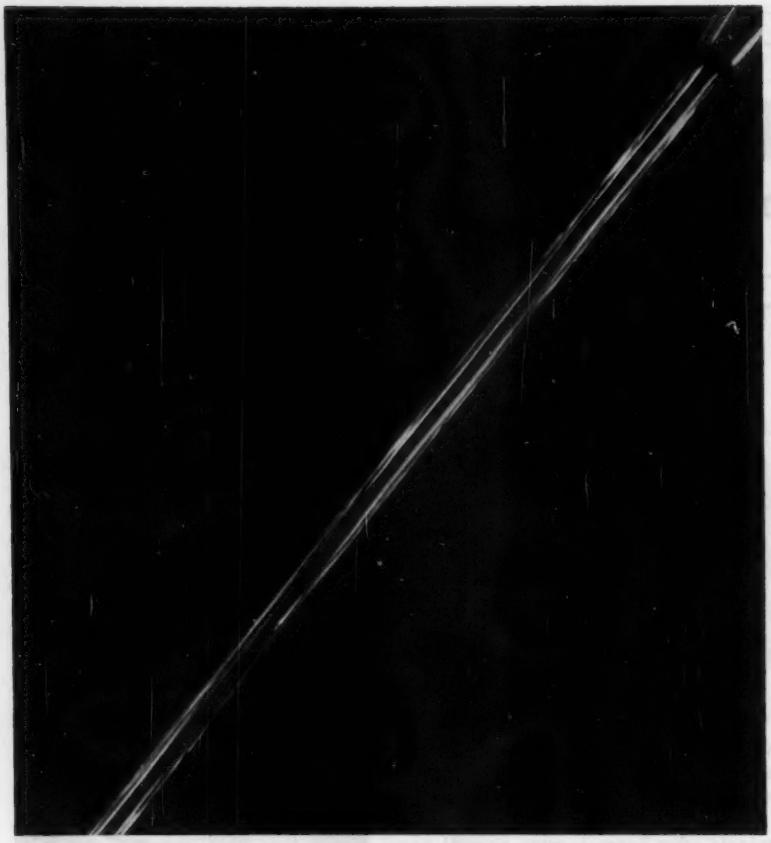

Using stop motion, photographer Bernard Hoffman 'freezes' a tiny jet of water. Discharged at high pressure, the stream is a solid, unwavering mass.

Controlling Pressure in Fluid Engineering

Pressure is always a problem . . . either how much you need, or what you can do in spite of it. Accurate control requires the relation of other factors, like volume, time, and resistance. To get these answers, you can depend on the engineering leadership of S. Morgan Smith.

Take butterfly valves. Parts for a wide range of standard R-S Butterfly Valves, capable of satisfying most processing requirements, are carried in stock for fast assembly and shipment. These R-S Valves, with their streamlined vanes, give you minimum pressure drop, save pumping power. Regulation and closure are quick, and you get uniform flow control through all positions in the normal regulating range.

To obtain full information on the complete SMS line—R-S Butterfly Valves, Rotovalves or Ball Valves—call our nearest representative. Or, write S. Morgan Smith Co., York, Pa., for data on standard valves or special applications.

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AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

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Suppliers . . .

and has been chief engineer at Toledo since 1946. He was graduated in engineering from Texas A. and M. College.

Tauson started with National Supply in Kansas. He left the company in 1940 but returned in 1950 as a research engineer. He did much of the hydraulic engineering for the company's line of heavy duty torque converters. He has an aeronautical engineering degree from the University of Oklahoma.

Wolverine Tube has appointed **Robert C. Crowe** as manager of Industrial sales. He succeeds **E. W. Ervasti** who recently became general sales manager of Calumet & Hecla of Canada, Ltd. Crowe joined Wolverine in 1950 and his most recent assignment was sales representative in the Detroit area.

The Girdler Co. has promoted **Paul B. Boyd** to the technical sales staff of the catalyst department. Boyd obtained his B.A. degree in chemistry at Centre College, where he later taught. He joined Girdler in 1944, serving as an analytical chemist in the field and assisting in new plant start ups. In 1951 he was put in charge of the analytical laboratories and in 1954 was moved to the technical service group.

Lamson Mobilift Corp., Portland, Ore. has appointed **Karl C. Schmedicke** as manager of manufacturing. Schmedicke, a native of Flensburg, Germany, studied engineering at the University of Hamburg and then came to the United States. He began in this country as a tool and die maker in a small shop, then joined General Aniline Corp. as an engineer. He came to Syracuse in 1945 as superintendent of manufacturing at Remington Rand and was later assigned to set up a new operation in Glasgow, Scotland. Upon completion of this assignment he returned to the Rollway Bearing Co., Syracuse where he became superintendent. In 1954 he joined Lamson Corporation.

Rockwell Manufacturing Co., has named **Joseph A. Heiman** purchasing agent for its Instrument division at Tulsa. Heiman was formerly a senior buyer in Rockwell's general purchasing department at Pittsburgh, Pa. He is succeeded by **James N. Huber,** formerly purchasing agent with Fort Duquesne Steel Co. and Keystone Fabricating Co., both of Pittsburgh.

The Patterson Foundry and Machine Co. has appointed **Everett A. Sisson** director of sales. Prior to his joining Patterson, Sisson was sales manager of The Osborn Manufacturing Co., Cleve-

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Here's how *Insul-Mastic* PROPERLY PROTECTS Industrial Equipment . . . at LESS COST!

You gain *all the essentials* when you specify Insul-Mastic to protect your plant and equipment investment against weather and damaging industrial vapors.

First, you gain the benefits of recognized superior products. For example, Insul-Mastic Type D has a record of performance 5 to 10 times longer than ordinary mastics. One of the reasons for this extreme serviceability is the higher content of "Gilsonite", probably the most resistant and stable material used in mastic coatings. Worth remembering, many coatings contain *no* "Gilsonite."

Second, you benefit from the experience of the pioneer in the mastic coating field. That means *proper application* — and faster application, too.

Putting on the best, costs less no matter how you figure it!

Think first of the coatings that last!

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CORPORATION OF AMERICA
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- ☐ **VAPOR SEAL MASTICS** — Eight types to meet every vapor sealing need.
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- ☐ **COLOR-COAT** — A lasting color finish developed especially for Insul-Mastic protective coatings. Also for concrete, brick, cinder block, metal trim, porous roofing tile, asbestos shingles, stucco, etc.
- ☐ **MICA INSUL-MASTICS** — A full line of products for a beautiful lasting coating.
- ☐ **POLY-CELL** — A unique foamed-in-place insulating material with many uses.
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- ☐ **GLASS MEMBRANE** — A superior inorganic fabric for reinforcing Insul-Mastic protective coatings.
- ☐ **MASONRY COATINGS** — Six types provide economical solutions to many masonry problems. White, clear and colors.
- ☐ **ACCESSORY ITEMS** — Caulking compounds, mastic and weathersealing cements, primers, thinners and aluminum spray.

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It's new
NOCON

TYPE #425

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SAFETY SOLVENT

REPLACES
CARBON – TETRACHLORIDE

Flash Point ..... None
Toxicity (Cal. M.A.C.) ... 500 ppm. plus
Corrosion tests (on metals) ... Negative
Evaporation rate comparison 1

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NOCON PRODUCTS CORP.
62 William Street
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Suppliers . . .

land. He is a member of the American Management Association and the National Sales Executive Association.

E. I. du Pont de Nemours & Co. Inc., was owned by 167,331 stockholders as of September 30, 1956, an increase of 12,034 over the number as of Sept. 30, 1955.

There were 152,417 holders of common stock and 21,109 holders of preferred stock as the third quarter of 1956 ended. These figures include 6,195 holders of more than one kind of stock.

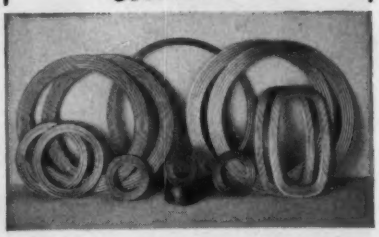
Every state in the union continued to be represented among the owners of the company.

Bailey Meter Co. has appointed **George D. Williams** Boston district office manager. He succeeds **P. T. Reuter** who died October 5. Williams, who joined Bailey Meter in 1946, graduated from Worcester Polytechnic Institute with a degree in mechanical engineering.

Diamond Alkali Co., Cleveland, has appointed **Thornton F. Holder** to the post of director of research. He replaces **Dr. Albert W. Meyer,** who has resigned from his present position as director of exploratory research. Dr. Meyer plans to continue in the field of chemical research and will announce his plans in the near future.

In addition to taking over direction of

Need Plain or Jacketed CORRUGATED METAL GASKETS?



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Chicago-Wilcox understands the gasket requirements of refineries and is equipped to supply all types of gaskets, including plain or jacketed corrugated metal gaskets like these. Made of ingot iron, aluminum, stainless steel, copper, brass, nickel, and monel in all sizes and shapes.

Send specifications for quotations and prompt-delivery schedule.

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Filter problem?

Solving your hydraulic filtering problems, with savings, is our service to the Refining Industry.

Schotco Wax Filter Press blankets are treated to eliminate penetration of foots. Saving valuable equipment and labor.

We have standard sizes in stock, with specials made to your specifications.

Schotco blankets outlast others, additional savings for you.

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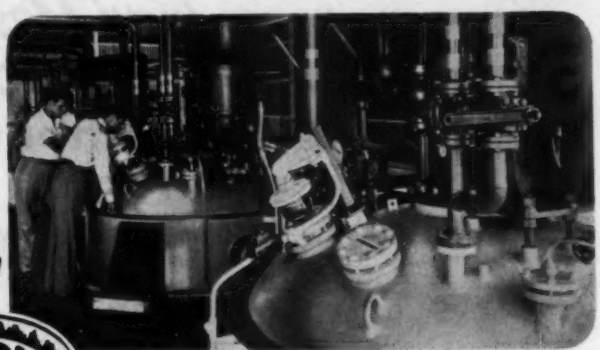
Synthetic Rubber Industry Increases Output with



TRADE FRICK MARK

Refrigeration

Reactors Cooled With These Frick Coils Make Rubber Twice as Fast.

The big plants making synthetic latex at Baton Rouge, La., Naugatauk, Conn., Louisville, Ky., and Borger, Texas, have lately installed special Frick cooling systems for holding critical temperatures in reactors—in such remarkable fashion as to more than double their output! The advantages of "cold" rubber are thus made more available to everyone. Whatever the cooling problem in your business—air conditioning, ice making, quick freezing, or process work—you can rely on Frick refrigeration to solve it with dependability.

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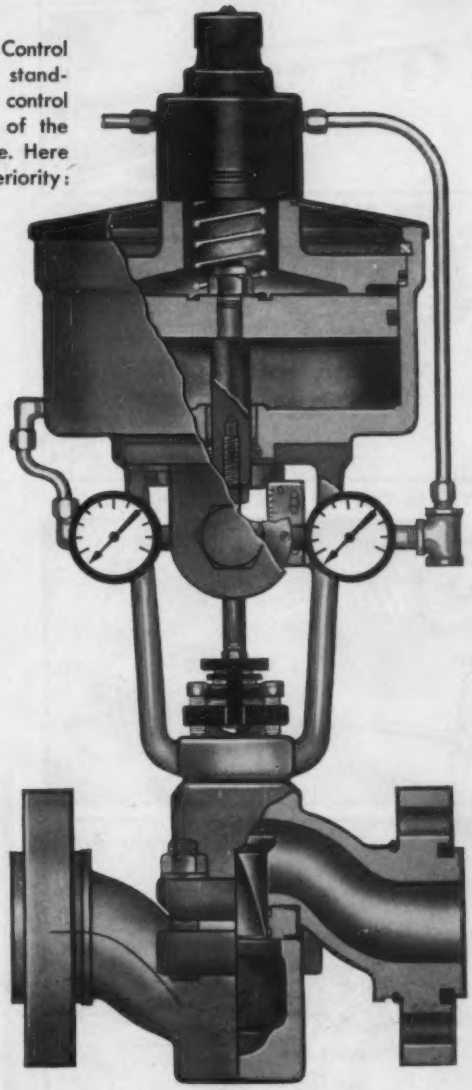
LOW FIRST COST
LOWER INSTALLATION COST
LOWEST MAINTENANCE COST

CONOFLOW *Series LB* CONTROL VALVES

Users say Conoflow Series LB Control Valves save more from every standpoint than any other type of control valve. This is based on years of the toughest applications experience. Here are the major points of superiority:



EASY TO INSTALL

Saves manhours. Compact, light yet strong.

INTEGRAL BONNET

Eliminates leakage at joints. Extra deep stuffing box for heavy duty packing. Oversized stem.

RENEWABLE SEAT RING

Quickly replaced with valve still in the line. No threaded insertions to corrode.

INTEGRAL POSITIONER

No exposed moving parts. Convenient zero adjustment while in operation.

PISTON POWERED

Sufficient power to operate under most adverse conditions. No diaphragm to fail.

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Guaranteed tight shut-off over long periods of time despite heavy wear.

STREAMLINED PASSAGEWAY

No cavities for accumulation of deposits to interfere with operation.

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FOREMOST IN FINAL CONTROL ELEMENTS

NOW!

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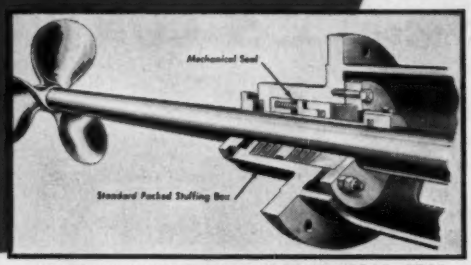
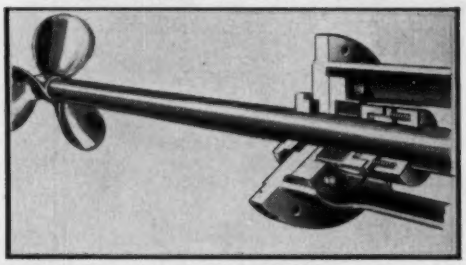
AGITATORS

With Mechanical Seals



TYPICAL INSIDE TYPE MECHANICAL SEAL

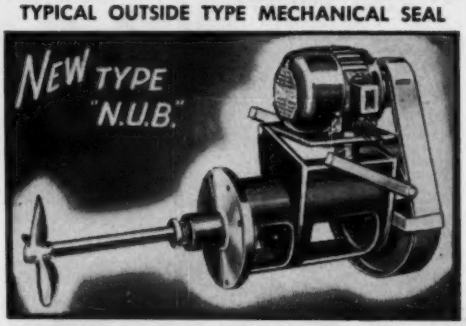
Specifically designed to resist corrosion, high temperatures and pressures —to seal toxic or flammable fluids perfectly without losses,—to reduce fire hazard, power, labor and repair costs, with much longer service and fewer shut downs. Certain applications show reduction of friction up to 83% over conventional packings— No scoring of shafts—permits specially designed sealing of gritty and abrasive fluids.



TYPICAL OUTSIDE TYPE MECHANICAL SEAL

New "International" Mechanical Seals

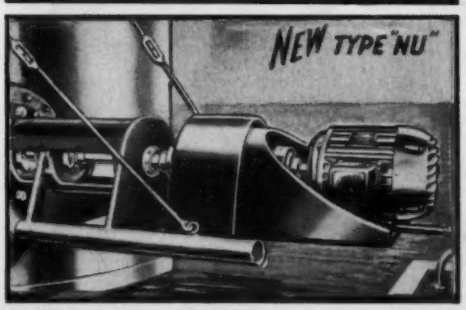
INTERNATIONAL can furnish either standard packed Stuffing Box or Mechanical Seals.—On Side Entering Mixers either Seal can readily be converted to the other, if desired, as shown in upper right hand illustration.



SHUT-OFF CONNECTION on side entering mixers allows repacking or replacement with either standard Stuffing Box or Mechanical Seals with a full head of liquid, without appreciable leakage.

Technical Bulletins Available

INTERNATIONAL stands back of its product with expert engineering service help when you need it. Over a Quarter Century of complete coverage in Petroleum Agitation—Remember to investigate "INTERNATIONAL" when you want prompt action and Guaranteed performance—Ask for Special Bulletins on Top Entering, Side Entering and Portable Mixers today.



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Suppliers . . .

Diamond's exploratory research program, Holder will continue to be responsible for its patent and trade mark activities and supervision of general-purpose research facilities and operations otherwise unassigned.

LaSalle Steel Company has announced T. Lloyd Kelly as chairman of the board, effective immediately. A graduate of Cornell, he started with LaSalle in 1921 advancing through numerous positions in both production and sales and was elected president in 1945. He has over 35 years of service with the company.

Thomas A. Kelly, former executive vice president, has been elected president and chief operating officer. Kelly is a graduate of Phillips Academy, Andover, Mass., Yale University class of '43, and an alumnus of the University of Chicago Executive Program. During World War II he served overseas as an artillery officer.

Minneapolis-Honeywell has named **Henry F. Dever**, president of its Brown Instruments division. He will be responsible for the over-all planning in the industrial controls field and will counsel and coordinate the engineering and manufacturing operations of seven M-H divisions now active in this field.

Dever, a 30-year man with Honeywell, was vice president in charge of engineering in Minneapolis before moving to Philadelphia to head the Brown division. He is also president of the Scientific Apparatus Makers Association.

United States Steel Corp., has appointed **Lloyd G. Depner** assistant manager of Cleveland district sales of the American Steel & Wire sales unit. Depner, who started with the division back in 1937 as a "co-op" student at Fenn College, moved up into the post relinquished by **Reid C. Pierce** who retired.

A native Clevelander, Depner was born in the Collinwood area. He attended East Clark and Collinwood Schools before en-

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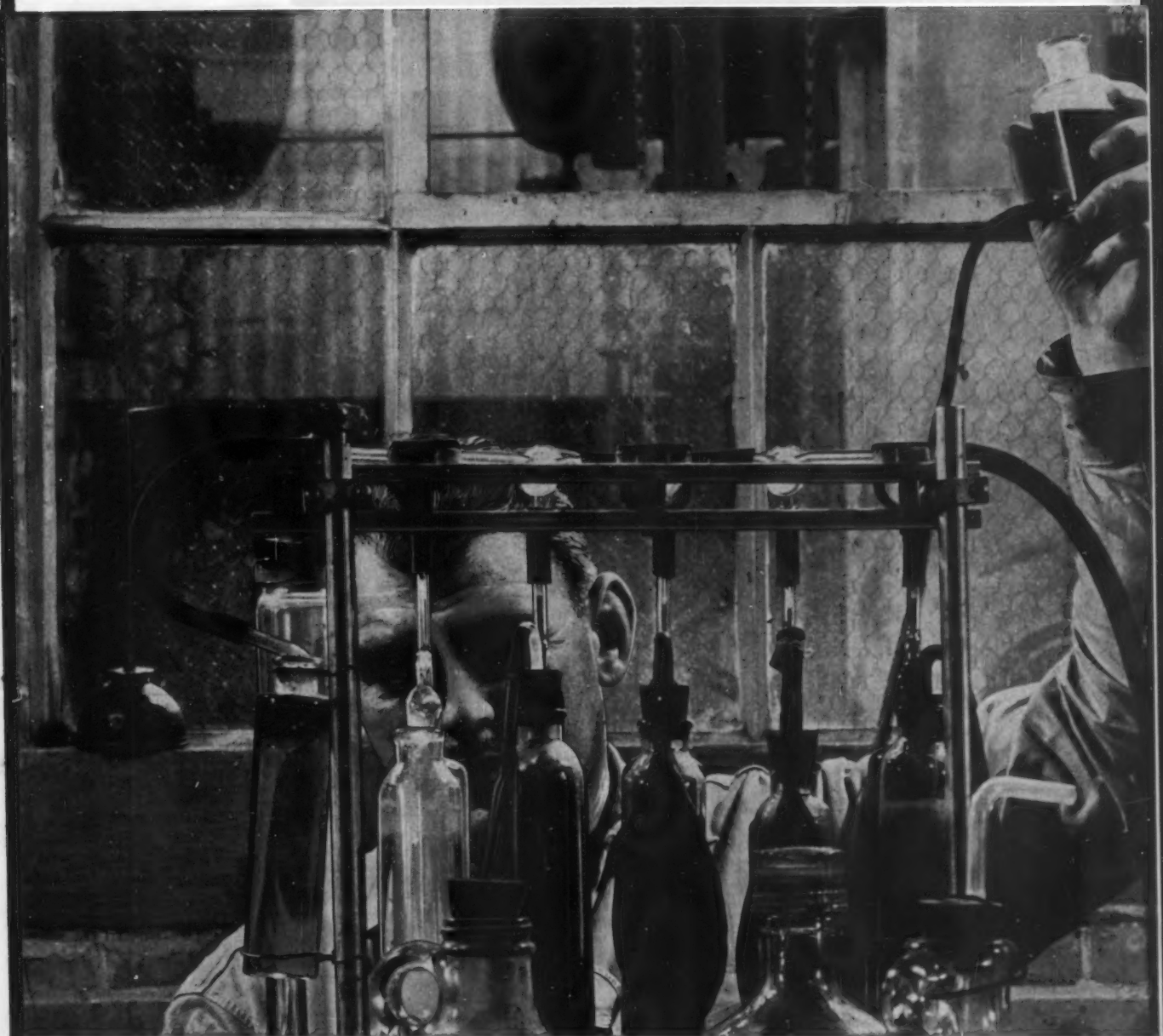


Photo courtesy Standard Oil Co., (N. J.)

boost average ratings as much as 2 octane numbers *with the LJUNGSTROM® AIR PREHEATER*

With waste heat recovered and returned to the furnace in combustion air, the most modern heat-transfer systems can be operated at peak efficiency.

That's why you boost product quality with the Ljungstrom Air Preheater. Its heat-recovery efficiency makes possible advanced furnace designs that assure remarkably close control of processing. And finer control means a more uniform product . . . with average ratings as much as 2 octane numbers higher. One still's added income just from higher product quality is $58,000 annually.

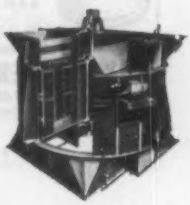
How fast is "WRITE-OFF"?

In earnings from higher octane ratings, many refiners write off the cost of the Ljungstrom installation in less than two years. This time is cut to nine months and even less, when the other Ljungstrom advantages are taken into account – saves up to 20% in fuel costs . . . permits more economical furnace design, with no need for convection surfaces . . . burns many fuels you used to throw away . . . results in consistently higher through-put . . . and minimizes slag.

For more complete details on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits obtainable in fuel burning equipment – call or write The Air Preheater Corporation.

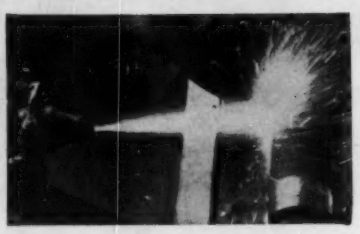
Wherever You Burn Fuel, You Need Ljungstrom

The Ljundstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.



The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

METALLIZING



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Suppliers . . .

tering Fenn College. He graduated in 1939 with a degree in business administration, majoring in economics.

Beckman Instruments Spinco division is in the process of constructing a new research and development center in the Stanford Industrial Tract at Palo Alto, California, to contain 30,000 square feet and cost $500,000, including land. Upon completion it will house the Shockley Semiconductor Laboratory, as well.

Chemical Construction Corporation plans to expand its engineering design and construction services and will undertake projects in both the chemical and petrochemical processing industries. This was revealed recently by **George Walker**, president of **Electric Bond and Share Company**, who also indicated that recent acquisition of Chemico by his company provides for independent operation of the wholly-owned subsidiary. Chemico was founded in 1914 and specializes in the engineering and construction of chemical plants both here and abroad.

A. W. Cash Co., Decatur, Ill., and its subsidiary, Cash Standard Stacon Corp., have announced the appointment of **William Schupner** as chief engineer for Fluid Power Products. A graduate of Lehigh

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Our eight pages in the 1957 Refinery Catalog present a complete picture —Descriptions—Specifications—Data.

You'll like the scope and quality of our products and service. The equipment you need available from stock or made to your exact requirements.

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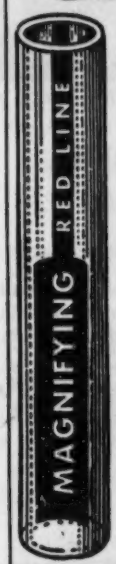

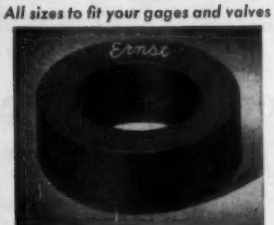

FIG. 22 SERIES 750 O

FIG. 21 LIP-MOLD

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All shipments from stock.
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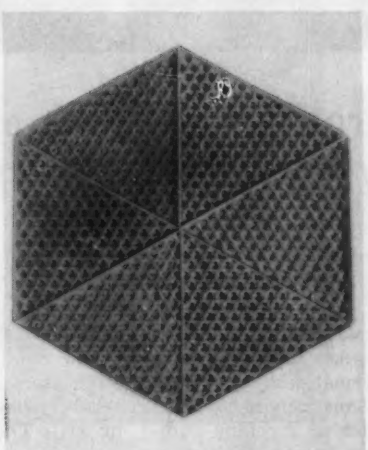

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LOW PRESSURE DROP
LOW HOLDUP

USED COMMERCIALLY OVER TEN YEARS

Bulletin and Additional Information on Request

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From Regina to Saudi Arabia

B-L VESSEL LININGS SET RECORD AFTER RECORD FOR DEPENDABLE PERFORMANCE

It looks like a Cook's Tour—but it isn't. Instead it's a listing of recent Bigelow-Liptak refinery installations in far-flung corners of the world.

There are good, solid reasons for this world-wide preference for Bigelow-Liptak jobs. In the first place from B-L's years of experience has come a complete castable package. Insulating- and abrasion-resistant castables are engineered, furnished and installed by the same company—which means just one contract and one responsibility.

The overall result of this all-in-one engineering is exceptional durability and performance. B-L refractory installations have established world records for continuous operation. For example, after initial runs of 785 and 610 days, B-L linings were in perfect shape—required no repairs during shutdowns.

Yes, from Regina to Saudi Arabia—and points in between—Bigelow-Liptak installations are setting new records for service and performance. For complete information write for the B-L catalog "One Source". Do it today!

A FEW OF OUR RECENT JOBS

Montreal, Canada	Regenerator
Regina, Canada	Regenerator and Cyclones
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Ras Tanura, Saudi Arabia	Regenerator—Reactor
Copenhagen, Denmark	Kiln-Reactor
Antwerp, Belgium	Kiln
Norco, La.	Regenerator and Cyclones
Altona, Australia	Reactors
Mandan, North Dakota	Regenerator and Cyclones
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AND BIGELOW-LIPTAK EXPORT CORPORATION
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and Now! ---- CARTAGENA, COLOMBIA

All of the castable refractories required for a complete cat cracker—including a regenerator and reactor and the interconnecting lines—will be furnished by Bigelow-Liptak for a job now going up at Cartagena, Colombia. In addition, B-L will furnish erection help and supervision.

For more data on advertised products, use Readers' Service Cards, last page.

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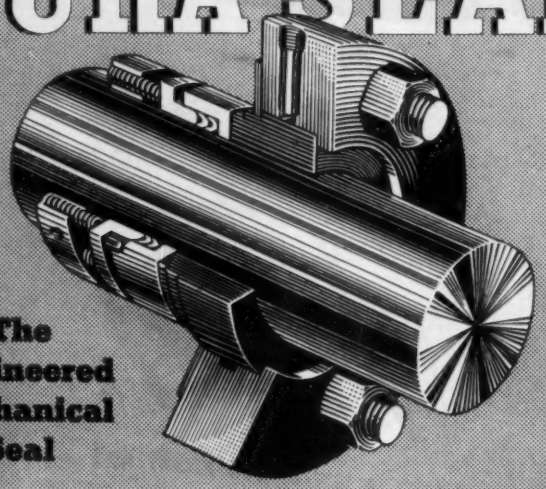

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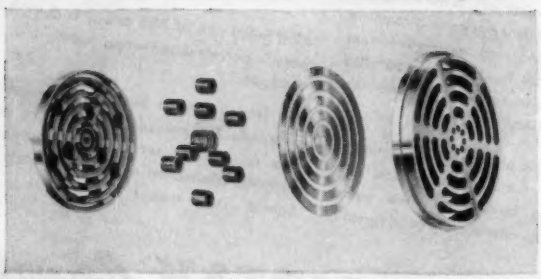

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Our detailed proposal will be sent without obligation. Send name, bore, stroke and speed of machine.

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Suppliers . . .

University, Bethlehem, Pa., Schupner was formerly chief research engineer for Hanna Engineering Work, Chicago.

A. O. Smith Corp., has elected three new officers of the company. Named as vice presidents were **U. T. Kuechle,** who has been automotive general sales manager since 1954, and **Roy A. Dingman,** who joined the company in April, 1956, as director of industrial relations. **Robert A. Rietz** was named assistant secretary.

Kuechle joined A. O. Smith in 1929. He worked for a short time in the Personnel department, then went into automotive sales. Dingman was industrial relations manager of the Weyerhaeuser Timber Co., of Tacoma, Washington, from 1948 until he joined A. O. Smith. Prior to that he had been vice president in charge of industrial relations for the Commonwealth Edison Co., of Chicago.

Rietz came to A. O. Smith in 1948 after graduating from Cornell University and taking postgraduate work at the University of Wisconsin.

Baird Associates-Atomic Instrument Co. has appointed **Wilburt M. Draisin** as promotions manager and **Arthur L. Krasnow** as assistant sales manager.

Draisin, a manager of the Baird staff since 1947, will coordinate all company promotion. Prior to his present appointment, Draisin was a research and sales engineer with the company. Before joining Baird, he was treasurer and general manager of Anro Ink and Chemical Co., Wakefield, Mass.

Krasnow, who will direct sales of the company's instrument lines under Cronkhite, will also serve as liaison between Baird-Atomic's sales, engineering and production departments. He has been on the Atomic staff since 1952 and prior to merger of both companies last June, was assistant sales manager and administrative assistant to the president.

The Girdler Co. has appointed **Robert Habermehl** to the technical service staff of the catalyst department. Habermehl obtained his B.S. degree in chemistry at

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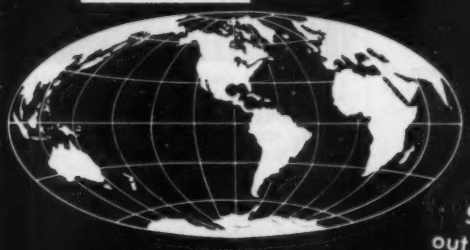

SAFETY has about the same connotation throughout the Petroleum Industry of the World—whether it be in the steaming jungles of Indonesia, the burning sands of the Middle East, or on the endless plains of TEXAS.

Life is dear to every man, whether he be a laborer or a man of high estate. His SAFETY is of deep concern, not only to himself, but to those dependent upon him—his family and his employer.

Petroleum equipment like petroleum itself is very valuable, and the more inaccessible and distant its location, the higher its cost becomes. Wherever it is, it is worth PROTECTING and the entire Petroleum Industry is alert to providing the necessary safeguards.

For nearly Forty Years, SHAND & JURS COMPANY has been a leading supplier of SAFETY and CONSERVATION EQUIPMENT to the Petroleum Industry of the World, and to make it available to all who need it, identical equipment is made both in the United States and in Great Britain, so if you deal in Dollars or in Pounds you may avail yourself of the Worlds Best in TANK SAFETY, CONSERVATION and ACCESSORY EQUIPMENT.

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The Mineralab—most complete and practical cabinet ever designed for fluorescent inspection—in the lab or in the field.

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Operates on batteries for field use, on 110-volt AD-DC in lab. Light weight, compact for easy carrying.

As a complete, self-contained darkroom, the new MINERALAB is ideal for "on the spot" inspection close to the problem being studied—for inspection of oil cores and cuttings at the rig or in the open laboratory.

Write for full details to Black Light Corp. of America, Distributors for Ultra-Violet Products, Inc. 5114 Walnut Grove Ave., San Gabriel, Calif. (Offices in principal cities.)

Suppliers . . .

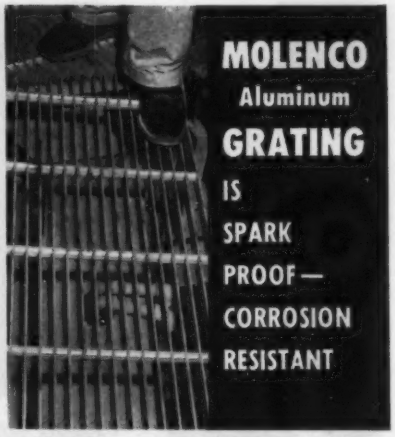
the University of Kentucky and was an instructor at the Augusta, Ky., high school before joining Girdler in 1950 as a member of the research and development group. Initially, he was engaged in developing and evaluating the performance of catalysts. Later he became the supervisor of a research group.

Missouri Refractories Co., Los Angeles, has announced that **Robert J. McCarthy**, president and general manager, will retain his position as head of the refractories wholesale firm while acting under appointment of Mexico Refractories as general manager of their Atlantic division.

McCarthy, previous to organization of the Missouri Refractories Co. in 1951, was engaged in firebrick and general construction work for 19 years.

Burgess-Manning Co., Penn Instruments division, has appointed **R. J. Medkeff**, chief engineer; **William Melas**, consulting engineer; **Adalbert Melas**, service manager; and **Clifford C. Harris**, assistant secretary.

Walsh Refractories Corp., St. Louis, has added **Lee Hartman** to its sales staff. An experienced refractory sales engineer, well versed in the application of fire brick and fire clay specialty materials, Hartman has been assigned to the Chicago industrial area.



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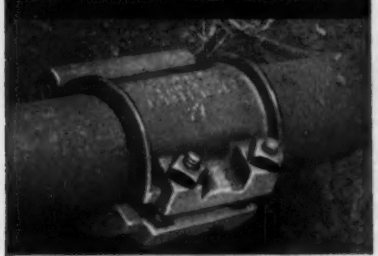

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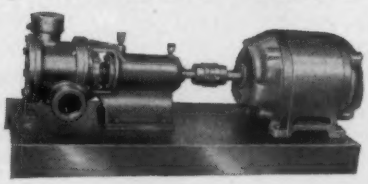

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Modern industry offers a challenge in the form of new and difficult applications which demand improved pumping techniques. In the Type Z4 APCO Turbine-Type Pumps will be found the complete answer to many of the applications involving liquefied gases and other light, non-viscous liquids. Obtainable in special metals with notable economy.

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NOW! A CATFORMING

Here's important news for refiners who are finding it increasingly difficult to meet today's higher octane requirements with present processes and catalysts. Atlantic offers an advanced Catforming catalyst designed to do a better, more economical job. The new catalyst combines ability to make higher octane quality products and an improved stability. These catalyst qualities mean greater process flexibility, and they are applicable in your present equipment. For full information on Catforming, write, wire or call The Atlantic Refining Company, P.O. Box 8138, Philadelphia 1, Pa.

NEW CATALYST

HIGHER GASOLINE OCTANES THROUGH PENTAFINING

You can convert the low-quality n-paraffins (C_5, C_6, C_7) in your gasoline pool to high octanes! Pentafining, the process developed by The Atlantic Refining Company, makes it possible. For full particulars, write today to The Atlantic Refining Company, P. O. Box 8138, Philadelphia 1, Pa.

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For more data on advertised products, use Readers' Service Cards, last page.

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MOTOR ENGINEERS

(Anti-Knock Engine Testers)

Must have several years experience in both operation and maintenance of the F-3 and F-4 knock engines. Also needs supervisory experience. College degree not necessary. Plant is now being built near Houston. This is a chance to get in on the ground floor with a new, progressive company. Send resume including details of education, experience and salary requirements to C. E. Leach.

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P. O. BOX 777 **CHANNELVIEW, TEXAS**

OPPORTUNITIES WITH MONSANTO

CHEMICAL ENGINEERS-CHEMISTS

in

PROCESS INVESTIGATION and PLANT OPERATION

also

MECHANICAL ENGINEERS

for

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Monsanto Chemical Co. has several immediate openings in its Technical Service (Process Investigation) group at the Texas City plant.

These career opportunities offer initial assignments in process studies involving manufacture of monomers and petrochemicals.

Additional openings available in the production dept. to staff new operating units soon to go on stream. Also several openings in the maintenance department for Mechanical Engineers.

Pleasant working conditions in a growing, friendly Gulf Coast City. Excellent schools and recreational facilities.

If you have 0-10 years experience in petrochemical or allied fields and wish to move into a growing company, send a resume of experience with a letter of application to

Manager, Technical Recruiting

MONSANTO CHEMICAL COMPANY

P. O. Box 1311 **Texas City, Texas**

HELP WANTED

PONTIAC REFINING CORP.

A well established growing independent refiner has three openings for experienced refinery personnel:

PROCESS DESIGN ENGINEER

With a minimum of five years design experience and ability to work with mechanical design engineers. Scope of position is open and depends on available person.

OPERATIONS ANALYST

A general technologist with understanding of processing and ability to evaluate charge stocks and processing operations. Also requires thorough familiarity with product blending and the economics involved.

SAFETY AND FIRE SUPERVISOR

This position requires a person familiar with refinery operations and the safety and fire hazards of refineries, as well as the ability to organize and carry on a complete safety and fire-fighting program in a small organization.

Write, giving resume, to

PONTIAC REFINING CORP.

P. O. Box 1581, Corpus Christi, Texas

PROCESS ENGINEERS

With three to six years experience

Several qualified process engineers can broaden their professional responsibilities in our Process Engineering Department. They will design a wide variety of plants for petroleum refining and large volume petrochemical processing.

Assignments range from complete integrated refineries and chemical plants through all types of individual process units. The work includes heat and material balances, and computations for unit operations such as fractionation, heat-transfer, absorption and extraction.

Fine facilities, top salaries, new retirement plan. Write to the head of our Personnel Department, Mr F B Stratford.

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Engineers

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HELP WANTED

SPECIAL PETROLEUM REPRESENTATIVE

Established manufacturer of industrial processing materials has opening for a special representative in the Great Lakes Region.

Applicants must be 25-40 years of age, and must have petroleum refinery experience in the mechanical, engineering, processing, or operations department. 60% travel, salary, plus expenses.

This is an unusual opportunity for a capable man looking for permanency and above average earnings.

Reply giving full details of education, background, and personal status to Box 247-R, PETROLEUM REFINER, Houston, Texas.

HELP WANTED

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Supervisory research opening in Lion Oil, A Division of Monsanto Chemical Company for qualified person with at least 5 years experience in the formulation of petroleum products and non-automotive petroleum specialties. Refining experience desirable but not essential. Location El Dorado, Arkansas. Integrated refinery operations of moderate size. Real opportunity for advancement.

Address replies to:

E. R. Coley
Technical Recruitment Coordinator
Lion Oil Company, A Division of
Monsanto Chemical Company
El Dorado, Arkansas

HELP WANTED

JOB OPPORTUNITY

Engineer with 5 or more years experience in Refinery Operation. Position in Development Department making economic studies of existing and proposed Refinery and Petro-Chemical Operations. Southern location—Salary Open. Write Box 252-R Petroleum Refiner Houston, Texas.

INSTRUMENT TECHNICIANS

Permanent positions in new Petrochemical Plant for instrument technicians. B.S. degree is desired but not absolutely necessary. Experience in the selection, application, testing, servicing, calibration, maintenance and installation of instruments and related equipment for the control of chemical processes is required. Practical experience should have been in pneumatic, mechanical, and electronic instrumentation for the measurement and control of process variables, including layout of complex panels.

Plant is now being built near Houston. Send resume including details of education, experience and salary requirements to C. E. Leach.

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P. O. BOX 777 **CHANNELVIEW, TEXAS**

REFINERY ENGINEERING in Southern California

Several qualified graduate engineers – Chemical, Mechanical or Petroleum – can broaden their professional responsibilities in our Chemical Engineering Department.

Assignments will cover the application of processes to a wide variety of industrial plants, ranging from complete integrated refineries and chemical processing centers through all types of individual process units. The work includes coordination of chemical engineering, the selection and design of process equipment and machinery, and startup of completed plants.

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Engineers
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Applications are now being taken for the following positions:

Plant Superintendent

A mature and responsible person with thorough training and broad experience in both operation and maintenance of petroleum refinery equipment to have charge of both of these functions in the refinery, the pipe line and the terminal.

Chief Engineer

An engineer with general technological experience to have charge of both process design and mechanical design work. Scope of position is open and dependent on available person.

Chief Chemist

Responsible person with experience in petroleum product blending and familiarity with latest refinery laboratory methods.

Process Foreman

An operations supervisor of broad experience to work under the Plant Superintendent and to be in charge of all operating units.

Maintenance Foreman

An experienced supervisor familiar with all types of refinery equipment to work under the Plant Superintendent and to be in charge of maintenance and small construction in the refinery, pipe line and terminal.

Write, giving resumé including experience with processes listed, to

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P. O. Box 1581, Corpus Christi, Texas

Applications for other positions will be taken at a later date.

Chemical Project ENGINEERS

2 to 7 years experience

Newly organized section in our Engineering & Construction Division at Pittsburgh has openings for several project engineers. Need men with broad background in chemical and petrochemical plant work who have had process or project experience. Work includes the coordination of diverse process and project aspects involving other sections.

Must be familiar with the various equipment in Chemical Plants and must have an understanding of heat transfer, fluid flow, distillation, absorption and instrumentation. Assignments require the ability to maintain customer relations; to advise draftsmen on plant layouts, and to instrumentate process flow sheets.

Write giving details of experience and salary requirement to: Personnel Manager, Koppers Company, Inc., 108 Koppers Building, Pittsburgh 19, Pa.

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PROCESS ENGINEERS with Eight or More Years Experience

Our Process Engineering Department has opportunities for several experienced engineers who wish to follow their preferred fields in petroleum refining or large volume petrochemical processing.

Assignments will be primarily process design and economics — determination of overall process requirements, selection of processing steps, and economic evaluation of processes. Other work may include market analysis, industrial surveys, and technical assistance to sales.

Write to the head of our Personnel Department, Mr F B Stratford.

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Suppliers . . .

The Hays Corp., Michigan City, Ind., has appointed **Frederick M. Rutledge** manager of project engineering. Rutledge was formerly chief control engineer of Hays.

A graduate of the University of Alabama, he previously headed an instrumentation and control group of Southern Services, designers of power plants for a group of southern utilities.

Rockwell Manufacturing Co. has appointed **Robert B. Kitzmiller** Los Angeles district sales manager and **A. J. Komich** gas products manager of Rockwell's Meter and Valve division.

Kitzmiller, formerly gas products manager, joined the company in 1934 as production clerk. He was made a sales engineer in the Pacific Northwest in 1945 and became San Francisco branch sales office manager in 1951, district manager the following year and gas products manager in 1955.

Komich, who joined Rockwell in 1946 as a sales engineer in the Boston district office, was named gasoline and oil products supervisor for that office in 1951. He moved to Pittsburgh as assistant product manager early this year.

John A. Jackson, Consulting Sales Engineers, have opened offices in Trenton, N. J., to offer design service and technical advice on custom-molded or extruded applications for rubber, plastic and silicone materials.

Initially, the firm will be the mid-eastern representatives of the Goshen Rubber Co., Inc., Goshen, Ind.; The Sperry Rubber and Plastics Co., Brookville, Ind.; and the Syracuse Rubber Products Co., Inc., Syracuse, Ind., for these companies' sales expansion programs.

For nine years prior to forming his own organization, Jackson was sales manager of Stokes Molded Products, division of The Electric Storage Battery Co.

The Enjay Company, Inc., petrochemicals marketing firm, has appointed **J. P. Haworth** manager of the company's newly-established eastern sales division. At the same time **H. C. Evans,** who opened the company's Akron offices last year, was designated Akron district manager.

Haworth will be responsible for the operations of the company's field sales personnel in a nineteen-state area. He joined Enjay early in 1955, after fifteen years with the Esso Research and Engineering Co.

Evans joined Enjay in 1947, and previously had worked in the chemical-products operations of Esso Standard Oil Co. at the company's Bayway and Baton Rouge refineries. He opened Enjay's Tulsa offices in 1954 and served there until transferred to Ohio in 1955 to open the Akron offices.

HELP WANTED

RIO DE JANEIRO, BRAZIL

Two instructors are needed to teach process design in a graduate curriculum in Petroleum Refinery Engineering operated by Petrobras in Rio de Janeiro, Brazil. Instruction is given in English. Applicants should have advanced training in chemical engineering, and at least five years experience in process design, technical service and plant operations. Teaching experience not essential but is helpful. Salary will be that paid to foreign engineers in Brazil and will include transportation for self and family. Two year contract exempts you from U. S. and Brazilian income taxes. Salary paid in U. S. $. Please send complete personal details, particularly concerning experience, and recent snapshot, to

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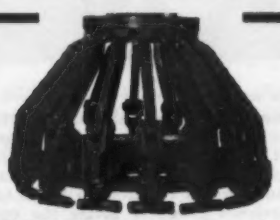

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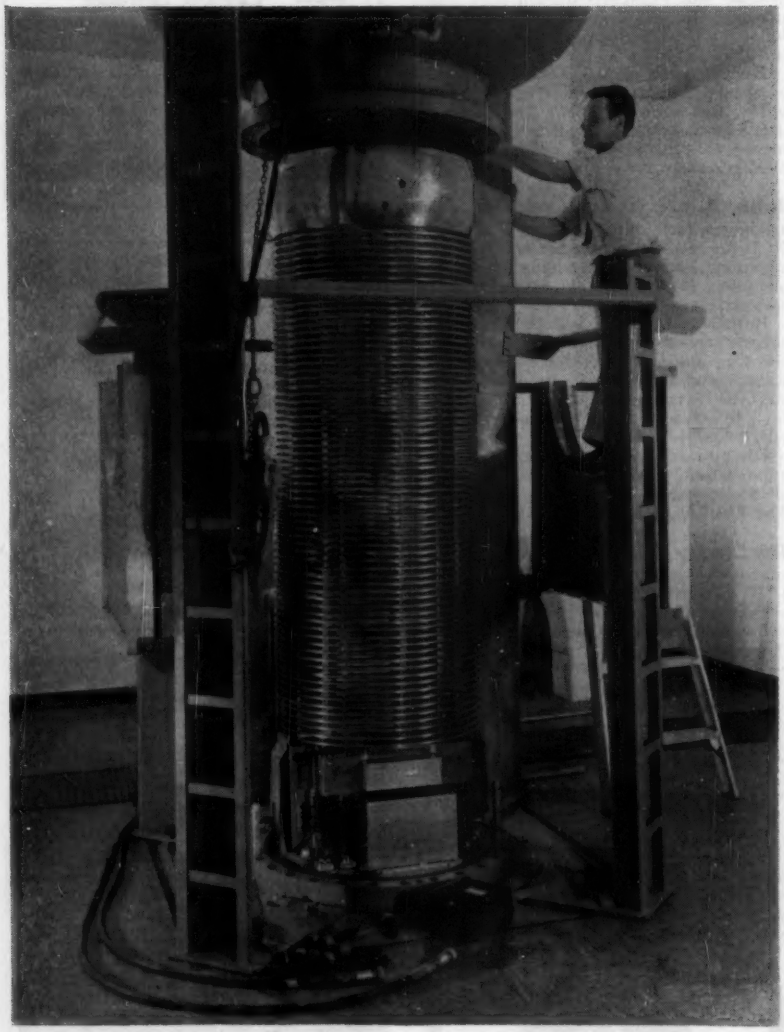

Van de Graaff Accelerator

A new research tool that probes scientific mysteries with a 3 million-volt beam of atomic particles traveling at nearly the speed of light has just been demonstrated.

The machine is a Van de Graaff Accelerator. It is the most powerful radiation source in industry. Depending on how it is used, it is up to 50 times more powerful than the largest cobalt-60 source in industry.

The new unit accelerates electrons to a speed of 184,400 miles per second—so near the speed of light that their effective mass is multiplied sevenfold. They thus become a new and powerful source of energy for research and processing.

A chief advantage of the machine is that it speeds research. Its high energy beam permits scientists to make in minutes or hours a number of studies that would take so long with other radiation sources as to be out of the question.

The accelerator will also aid in developing fuels and lubricants for the atomic age. It generates the same kind of radiation as that given off by atomic reactors and thus permits research on the behavior of petroleum products under the operating conditions that will prevail in atomic power plants.

The machine produces the active molecular "fragments" that are essential in chemical reactions but have so far been hard to study because they exist for so short a time. With the new machine, scientists can produce the fragments at sub-zero temperatures and keep them in crystalline lattices, which serve as deep freezes, for study at leisure.

A cyclindrical tank 11 feet high and 6 feet in diameter forms the accelerator's housing. A fast-moving rubberized belt carries electrons to an electrically isolated terminal at the top of the machine. As electrons are deposited at the terminal, the terminal is brought to a 3,000,000-volt potential. Electrons move from the terminal to a heated filament and from there are hurled through a vacuum tube to the bottom of the machine. Here they are directed through a thin aluminum membrane and on to the target in a room on the floor below. The beam of electrons is "scanned," TV fashion, to insure even distribution of electrons on the target and to avoid melting the aluminum membrane.

The accelerator is installed in a special radiation laboratory including four rooms: a generator room for the accelerator, a target room where materials are exposed to radiation, a control room and a chemical laboratory.

A closed television circuit and a system of mirrors are used in watching the operation of the machine from the control room. Shell Development Company.

Circle E1 green card, last page

Air Reduction Reprint Available—A 12-page reprint entitled, "Power Supplies for Gas Shielded Metal Arc Welding" by A. Lesnewich and E. Cushman is now available.

Reprinted from the Welding Journal, this paper details a study which indicates that a constant-voltage transformer-rectifier with automatic regulations for fluctuations in line voltage is the best general purpose machine for the inert-gas-shielded metal arc welding process. Air Reduction Co., Inc.

Circle E2 green card, last page

Cold Galvanizing Compound—A cold galvanizing compound that rustproofs iron and steel surfaces, prevents corrosion at welded joints and repairs damaged galvanized surfaces is illustrated and described in a new, four page, two color folder recently published. The folder describes how DRYGALV protects with zinc in the simplest and most economical way since it can be applied by brush or spray gun to produce a coating containing approximately 95 percent metallic zinc. The folder also describes how the compound is a time-saving, practical preparation for making galvanizing repairs away

New equipment is news!

It is for this reason that Petroleum Refiner devotes an entire section to the new products and literature presented by various manufacturers to the men of the refining-petrochemical-natural gasoline industry.

The equipment items presented in this section have been carefully screened by our New Equipment Editor so that you may keep pace with the new products in this constantly changing industry.

ESSO ENGINEERING NEEDS

- Mechanical Engineers
- Civil Engineers
- Electrical Engineers

MANUFACTURING

Mechanical, civil, and electrical engineers are required for project engineering, field engineering and equipment inspection work. Project engineering consists of laying out plant equipment and facilities, coordinating and preparing mechanical and structural designs. Field engineering work within the refinery is concerned with the installation of new equipment in accordance with layouts prepared by design engineers together with the maintenance of operating equipment and the development of methods and techniques for improving this work.

Equipment inspection activities center on inspection and study of the physical condition of plant equipment to determine its structural soundness, safety for continued operation, physical fitness for performing the required process function, and means of improving safety and equipment life.

DESIGN AND PLANNING (no drafting)

Mechanical, civil, electrical and other engineers needed in development and economic problems in (1) mechanical design and equipment, (2) utilities requirements for new refineries and modernization of existing refineries, (3) procurement from various manufacturers of materials used in refinery construction and maintenance (writing specifications, procuring bids and reviewing contract proposals).

BS and MS engineers with up to ten years' experience are invited to investigate. Give full details of education, experience, desired salary, availability date and references. All inquiries will be considered promptly and held confidential. Mail replies to:

ESSO RESEARCH CENTER-Employee Relations-C

Post Office Box 51 **Linden, New Jersey**

Esso Research & Engineering Company
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(Domestic Subsidiaries—Standard Oil Company [New Jersey])

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Petroleum Refining With Chemicals

By Vladimir A. Kalichevsky and Kenneth A. Kobe

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About The Authors

VLADIMIR A. KALICHEVSKY is widely known in the refining industry. Author of many articles on petroleum and a contributor to the REFINER since 1944, his published works include several books on refining. Kalichevsky joined Union Oil Company in 1924, after completing an engineering degree at California Institute of Technology. After some years as a research chemist with that company and a similar position with Standard Oil Development Company, he became a section leader in the Research & Development department of Socony-Vacuum Oil Company, Inc., and in 1937 was named general supervisor of the department. Since 1944, he has been consulting chemical engineer for Magnolia.

KENNETH A. KOBE is a professor of chemical engineering at The University of Texas, where he is also associate director of the Bureau of Industrial Chemistry which is engaged in research on natural resources. A registered professional engineer in Texas, he has been an industrial consultant since 1931. His industrial experience includes work with Bradley-Fitch Company on recovery of low-grade ores. Kobe also worked for Du Pont Ammonia Corporation and National Safe Protector Company, and was retained for three years as technical director for Manganese Products, Inc. He is the author of over 110 published articles, several of which have appeared in PETROLEUM REFINER.

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This book is a comprehensive up-to-date treatise explaining in easy-to-read language the various problems encountered in refining and finishing petroleum products. Detailed explanations are given on refining of petroleum with chemicals and solvents, use of additives for improving quality of petroleum products, modern testing methods and their interpretations, concept of color (as applied to color of petroleum oils), as well as other theories such as lubrication, viscosity, surface tension, vapor pressure, boiling point, fire and flash point, octane number, etc. The extensive list of thousands of patents on subjects covered, and the wealth of references to the literature are of particular value.

CONTENTS (condensed): Nature of Crude Oil and Preliminary Refining, Removal of Extraneous Materials, Products, Evaluation of Petroleum Products, Density and Specific Gravity, Vapor Pressure, Aniline Point, Acid Refining, Refining With Alkalies, Compounds of Alkali Metals, Refining With Adsorbents, Theoretical Principles, Distillation With Adsorbents, Ion Exchange Agents, Disulfurization and Sweetening, Analysis of Sulfur Compounds, Solvent Refining, Types of Refining Solvents, Solvent Refining of Petroleum Fuels, Solvent Extracts, Deasphalting and Dewaxing, Removing Oils From Wax, Additives for Non-Viscous Petroleum Fractions, Additives Used in Non-Viscous Oils, Anti-Detonating Characteristics of Fuels, Lubricating Oil Additives, Classification of Additives, Wax Modifiers, Lubricators, Inhibitors, Preventives, Appendix, Patent Index, Author Index, Subject Index.

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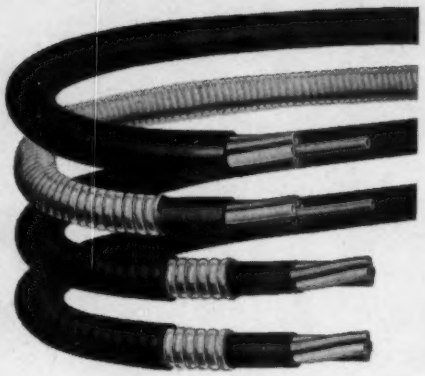

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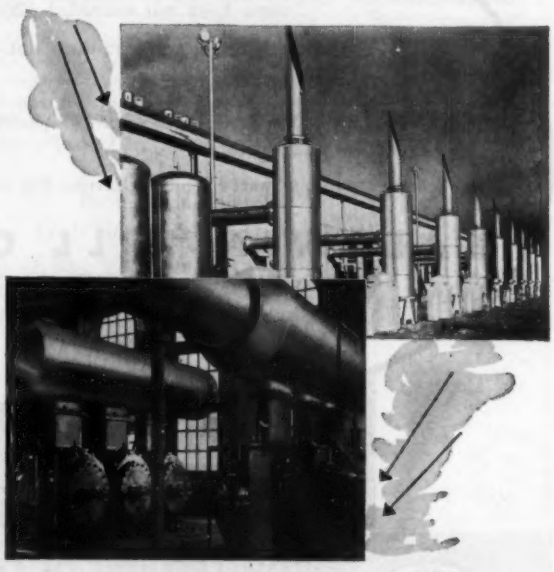

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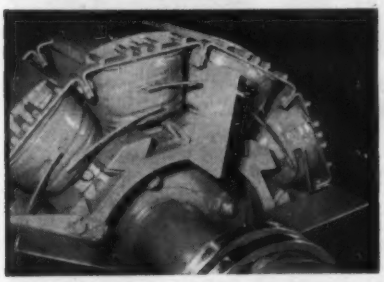

New Field Coil Insulating System —An "integrated" field coil with a newly developed insulating system designed to protect electric motors and generators against atmospheric contaminants and destructive mechanical forces has just been announced.

"Integrated" field coil construction is particularly well suited for applications requiring chemical resistance, oil and moisture-proofness, or sealing against atmospheric contaminants such as carbon black, dust and dirt. It is currently available for synchronous and dc machines subject to severe duty cycling in Class A and B temperature classifications. Studies indicate, however, that the system will eventually be available for Class H temperature applications.

Primary insulation in the "integrated" field coil construction is glass with fibers tailored and oriented for maximum strength. Solventless types of inorganic, heat stable resins augment the glass fibers.

These resins bond so well with coil conductors and pole surfaces that the structure is fused together into one integral part. The enveloping skin is inseparably locked with the coil and tightly pressure molded to coil contours.

This construction results in dimensional stability, mechanical strength and durability, toughness and resiliency, oil and moisture-proofness and chemical resistance. It can withstand the destructive forces of vibration and thermal shock, and requires little or no maintenance. Allis-Chalmers Manufacturing Company.

Circle E4 green card, last page

New Chromatography Instrument —As a field test instrument, the recently announced Chromanette is a new, portable instrument designed for the analysis of gases by vapor phase chromatography.

The Chromanette offers a rapid method of obtaining accurate analysis of field gases "on the spot." This new apparatus is finding application in the analysis of petroleum gases as in natural gas and natural

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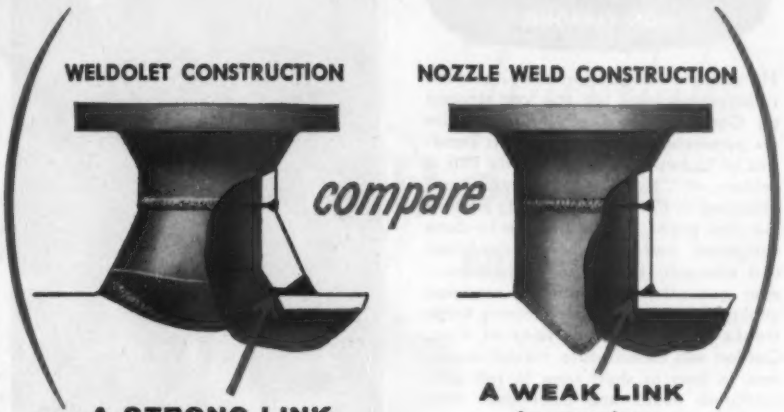

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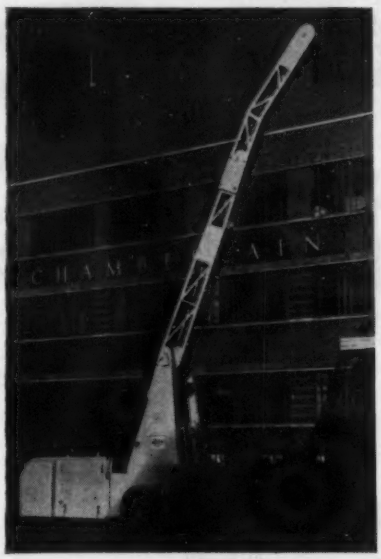
The instrument is rugged, inexpensive, easy to operate and provides sufficient accuracy for plant control and field testing. It is portable, weighing slightly less than 15 pounds, and may be carried like a "one suiter." Podbielniak Inc.

Circle E5 green card, last page



New Jib Extension—A special swan neck jib extension for use with the "Staffa 3," 3-ton capacity gasoline or diesel driven mobile crane is now available.

This extension, which provides a clear lifting height of 23 feet at an outreach of 7 feet 9 inches, considerably increases the range of the crane where light bulky loads are handled and has proved very useful to operators in timber yards, railway sidings and on docks, harbours, jetties and wharves.

The illustration shows the swan neck jib extension fitted to the standard jib and its simple design enables the conversion to be made in a matter of minutes.

Other accessories include a straight jib extension increasing the lifting height to 22 feet and maintaining a 2-ton lifting capacity. The standard crane can be supplied with a special long jib with a capacity of two tons at an outreach of five feet.

The "Staffa 3" mobile crane is completely mechanical and has been constructed to reduce maintenance to a minimum, and to ensure that where maintenance is inevitable it is of a simple mechanical nature.

The jib is raised and lowered by means of a hydraulic ram, and finger tip control provides accuracy and safety in all derricking operations. Chamberlain Industries Limited.

Circle E6 green card, last page

New Purifier Recovers Valuable Chemicals from Vapors and Gases—This unit separates mist, liquids, solids of any type from any gas or vapor by a series of patented vanes and baffles through the correct application of principles of centrifugal force. Separation efficiency has been improved through the use of new patented vanes and baffles to the point where the units are guaranteed to remove 99 percent or better of all liquid and solid particles in vapors and gases under normal operating conditions.

Executives of a leading New Jersey chemical plant who installed the purifier illustrated here at the base of a vent stack in a vertical upflow position to remove methanol droplets entrained in ether at the rate of 5000 pounds per hour. During the first day of operation the purifier recovered $360 worth of methanol.

An unusual feature of this purifier is the elimination of screens or filters of any type. This has permitted the design of a much smaller unit, as separation is accomplished in a relatively small area by a compact separating element. The purifiers are also maintenance-free and no parts require cleaning or replacement. V. D.

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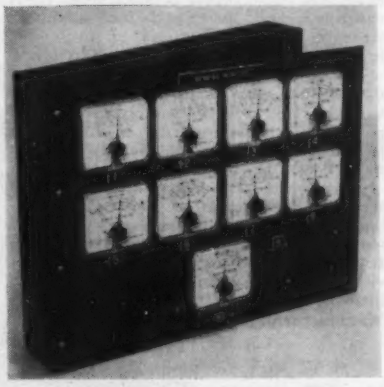

Bearing Monitor for Temperature Protection—A multi-point bearing monitor, providing centralized and automatic temperature protection for bearings in large stationary machinery installations, has just been announced.

The controller is especially suitable with such installations as diesel engines, standby electric generators, water pumping sys-

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prime manufacturers of

RASCHIG and LESSIG RINGS

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When you are in the market for Metal Raschig and Lessig Rings, buy from a primary source — Metallo the Manufacturer. Buy Metallo Raschig and Lessig Rings because it pays off in dividends of extra savings in time and money. 37 years experience assures you of top quality, top performance and lowest possible prices.

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Develop greater production capacity because they offer highest possible contact surfaces, high scrubbing capacity, thorough dispersion of gases and liquids and long life. Metallo Metal Raschig Rings do not crumble regardless of pressure or acid content. Furnished in all metals. Samples on request.

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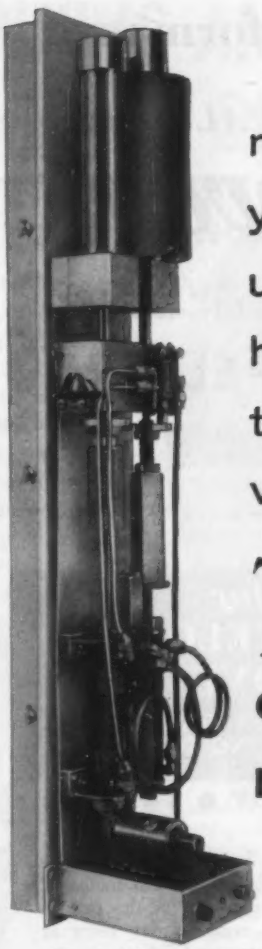

now you **can** use a short half-life tracer with the **new**

Tracerlab

Gamma Milker

Tracerlab's new Cs^{137} — Ba^{137} Gamma Milker is a compact system for injecting the 2.6 minute half-life Barium^{137} into pressurized systems for precise flow measuring and tracing operations *without any danger of permanent contamination of the material under study.*

And this unique Gamma Milker offers another big advantage . . . the Cs^{137} produces its "daughter" isotope, Ba^{137} constantly. Thus you are sure of as many as 20 "shots" before the Cesium cartridge needs replacing.

For full information on the new Tracerlab Cs^{137} — Ba^{137} Cartridge for short half-life isotope work, write for Bulletin No. 84.

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130 High Street, Boston 10, Mass.
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Offices in principal cities throughout the world

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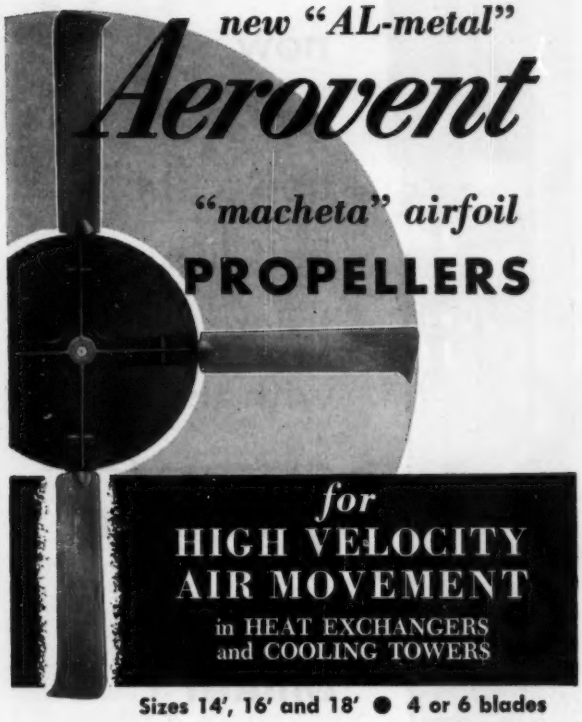
for top performance



Sizes 14', 16' and 18' ● 4 or 6 blades

New Aerovent "AL-metal" Propellers for Cooling Towers, Heat Exchangers and special commercial and industrial applications, feature a new modification of the famous "Macheta" Airfoil Propeller — regarded for years as *industry's most efficient air-moving surface!*

Accurately-balanced, cast aluminum blades, designed to move *more* air with *lower* power consumption, are interchangeable with other blades in each assembly to speed and simplify installation and routine maintenance.

High-strength, cast steel alloy hubs, employing bolted construction, clamp keyed blade shanks securely to prevent loosening or turning; provide maximum resistance to vibration and operating stresses.

designed for DEPENDABLE *operation*

Endurance tests at 3 *times* normal loading prove the ability of new Aerovent "AL-metal" Propellers to withstand punishment far in excess of operating requirements.

Other models for any type installation

Write today for free folder, engineering assistance and/or detailed performance data

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PIQUA, OHIO

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PROCESS PROTECTS REFINERY EQUIPMENT

More and more refineries are discovering the advantages of the new ALUMICOAT Process! ALUMICOAT offers a firm resistance against corrosive media — *especially sulphur compounds* — and extreme temperatures!

In the ALUMICOAT Process, refinery parts are dipped in molten aluminum to produce a metallurgical iron-aluminum bond at the interface and a surface overlay of pure aluminum. At temperatures exceeding the melting point of aluminum, the aluminum on the surface diffuses. This diffused coating, together with the iron-aluminum bond, provides a refractory material that gives steel maximum protection against high temperature scaling.

The Alumicoat Process can solve your corrosion and oxidation problems. Send for full details today!

ARTHUR TICKLE ENGINEERING WORKS, INC.
26 Delevan Street MAin 5-4200 Brooklyn, N. Y.

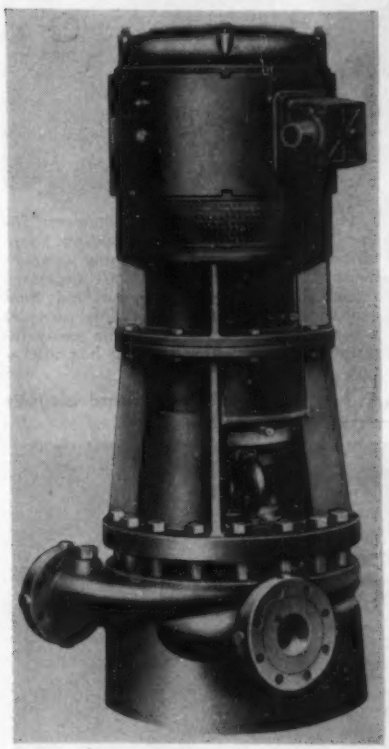
New Equipment . . .

tems, and petroleum pumping equipment. In these installations the cost of replacing burned-out bearings is usually greater than the cost of equipment for controlling bearing temperatures.

The controller may be set to permit different temperature limits for each bearing point being protected, within a normal range of zero to 500 F. If the temperature limit of any bearing point is exceeded, an alarm is sounded and if desired, the equipment is shut down automatically through actuation by the controller. Virtually any number of bearing points may be protected, at a cost per control point that is believed to be the lowest available.

In the controller, each bearing point is monitored by a contact meter-relay which provides a continuous indication of temperature below the pre-set limits. Each meter-relay has a response time of .2-second. Although the meter-relays operate automatically and thus do not require watching by an attendant, the indicating feature permits a quick visual comparison of temperatures in similar bearings. Tipp-Tronic, Inc.

Circle E8 green card, last page



Vertical Pump Offers New Pressure Range—When a new range of pumps for higher pressures was first contemplated a careful review was made and the Vertical pumps now being offered for pressures up to 350 psi are the direct outcome.

Basically the main attractions in Vertical construction are:

1. Compactness; taking only a fraction of the floor space required by a corresponding horizontal pump.

2. Ease of access to working parts. By lifting off the motor the whole pump can

2 WINNING ANSWERS TO THE $64 QUESTION—

HOW CAN YOU REDUCE OPERATING AND MAINTENANCE COSTS ?

Let's take a look at costs in the areas of: Crude Charge Service, Transfer of Heavy Gas Oil to the "Cat" Cracker, and the Handling of Plasticizer Oil and Bunker "C". Down-time is unthinkable . . . (but it does happen and it's costly). Then there's the extra cost in Btu where you're maintaining oils at higher temperatures than an efficient pump requires.

KINNEY provides two definite objective answers to your cost problems in handling heavy viscous materials . . . KINNEY Heliquad Gear Pumps and KINNEY Rotating Plunger Pumps. Both of these Pumps, on their records, outperform all other pumps costwise and in terms of trouble-free service.

HELIQUAD GEAR PUMP

ROTATING PLUNGER PUMP

Kinney®

HELIQUAD GEAR PUMPS

For long service and trouble-free performance. Positive displacement pumps with non-pulsating delivery . . . handle fluids ranging from gasoline to asphalt. Furnished in steam jacketed models for service where fluids must be heated to flow. Electric motor, steam engine, steam turbine, gasoline or diesel engine drive. Capacities 5 to 2500 gpm with pressures in most models to 300 psi.

Kinney®

ROTATING PLUNGER PUMPS

The design of these Pumps, without valves, makes them particularly suited to handle viscous liquids such as: lubricating and fuel oil, asphalt and other sluggish or gassy liquids. Positive displacement with high volumetric efficiency—frequently employed for calibrated output. Capacities 1½ to 600 gpm, pressures 70 to 250 psi. Plain and steam jacketed models.

WRITE . . . Get the dollar-saving facts about KINNEY Heliquad Gear and Rotating Plunger Pumps. Write for Bulletin No. L51A today!

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THE NEW YORK AIR BRAKE COMPANY
3596A WASHINGTON STREET • BOSTON 30 • MASS.

Kindly send me descriptive literature on KINNEY Pumps to lower Operating and Maintenance costs.

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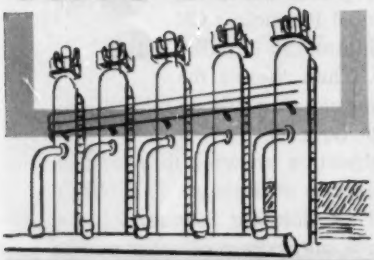
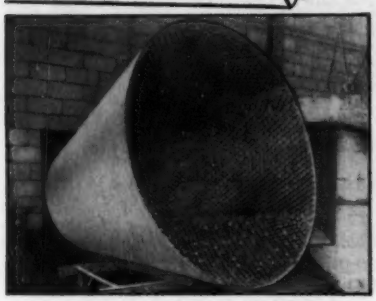
FEWER
"TURN-AROUNDS"





Shutdowns for repairs of fire clay linings in refractory units are expensive. The frequency and duration of these shutdowns can be greatly reduced by the use of a steel grating armor known as "Gridsteel", which holds the castable refractory linings in place longer and armors them against the bombardment of catalytic elements.

"Gridsteel" is available in a special loose clinch to conform easily to curved surfaces.

For complete information, write for brochure on Irving "Gridsteel" Contour Retainer Mesh

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IRVING SUBWAY GRATING CO., Inc.
Originators of the Grating Industry

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New Equipment . . .

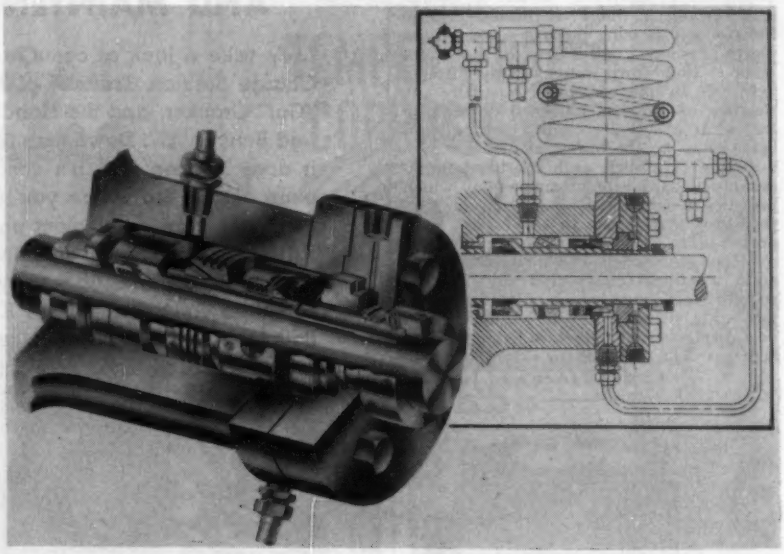
be dismantled without disturbance of the pipe work.

3. Reduces over-all length; the span of the ball and roller bearings being less than is necessary for a horizontal pump.

4. Increased rigidity of the pump end and the fact that the motor is not attached by feet to a baseplate (or wall) reduces the possibility of distortion due to pipe strain.

5. Stuffing box sealing is simplified due to the elimination of static deflection caused by an overhung impeller in the case of a horizontal pump. Rhodes, Brydon & Youatt, Ltd.

Circle E9 green card, last page



Boiler Feed Pump Mechanical Seal—A new boiler feed pump mechanical seal is now available. It is designed to provide much longer service life than that of other sealing methods, thus cutting replacement costs and "down-time." Maintenance expenses are also reduced. Once installed, the seal needs no further attention and replacement of expensive sleeves is eliminated. Loss of valuable feed water is prevented, since there is no leakage.

Long seal life is obtained through the use of a special closed circulating system. This engineered system provides cool water in sealing chamber assuring best seal performance.

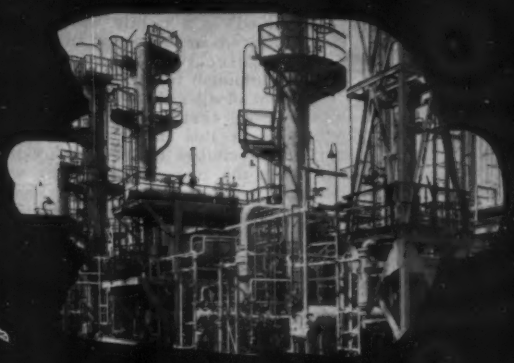
The new seal comes fully engineered for the particular operation, including adaptation to pump design and piping arrangement. Plans are furnished. All necessary recommendations are supplied and heat exchanger size is specified. This provides a complete package that can be easily installed without major stuffing box alteration. Crane Packing Co.

Circle E10 green card, last page

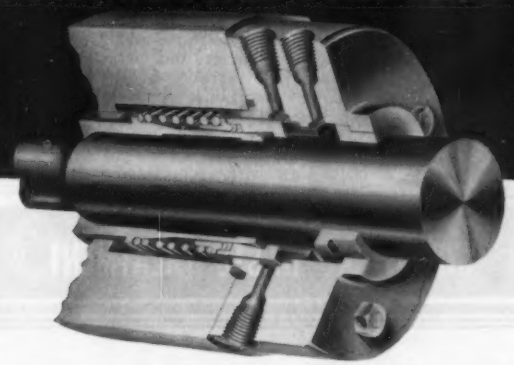
Electronic System Analyzes Boiler Operation—An electronic system designed to analyze the operation of a giant steam generating unit in a few hours a task ordinarily requiring weeks of work by a team of specialists, has just been developed.

By means of "sensing" elements linked to analog scanners, the system can probe hundreds of different boiler locations. At

MINIMIZE MAINTENANCE...



FILL THE HOLE IN YOUR SEALING REQUIREMENTS WITH SEALOL-FLEXIBOX!



Why are so many companies standardizing on Sealol-Flexibox Mechanical Shaft Seals? Maintenance personnel specify them because they provide minimum maintenance, drip-free operation, and can be easily assembled without adjustments and set screws. Sealing contact is maintained by positive mechanical means . . . automatically compensating for dimensional charges due to temperature and pressure variations.

By eliminating gland leakage you . . .

- prevent valuable product loss
- maintain cleanliness to cut labor costs
- do away with fire hazard conditions created by escaping volatiles

FLEXIBOX features design simplicity and sturdiness . . . adapts easily to existing or new pumping applications. Request Bulletin No. 10 for complete data . . . or ask for engineering recommendations. It pays to standardize . . . especially if you standardize on Sealol-Flexibox Mechanical Shaft Seals!!

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So SIMPLE that "Specials" are Likely to be Standard!

A sleeve, raised and lowered within a non-magnetic tube, attracts or releases an Alnico magnet attached to a mercury switch. Basically, this is Magnetrol

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LIQUID LEVEL CONTROL

Because of the utter simplicity of Magnetrol's magnetic operating principle, standard models can be easily adapted to meet any special requirements for pressure, temperature or corrosive liquids . . . and usually at little extra cost. This Magnetrol versatility has solved all kinds of tough level control problems . . . and given our engineers wide application experience that can be invaluable to you.

Magnetrol is so simple that failure is all but impossible! Using only permanent, unfailing magnetic force for its operation, there's nothing to wear out . . . no diaphragms or bellows to stiffen and rupture . . . no electrodes to short or corrode . . . no packing to bind or leak. Magnetrol is practically maintenance-free! Magnetrol units are available for controlling level changes from .0025-in. to 150-ft. . . . with multi-stage switching when desired. Send coupon for full details.

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Please send me catalog data and full information on Magnetrol Liquid Level Controls.

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New Equipment . . .

the touch of a button, it begins gathering such data as temperature, pressure and gas composition. Complex electronic devices, operating without human guidance, then sort the information, supplement it with pre-set figures, and punch it in code on continuous tape.

Tape readings are transmitted by teletype to New York where B&W has a large electronic computer. Translated automatically into code suitable for computer use, the information is processed mathematically and transmitted back to the boiler site for application by engineers and technicians.

The new system has been developed to help engineers determine quickly and economically such boiler problems as sources of heat losses, the most efficient types of fuels, and when and where to remove combustion waste deposits. Emphasizing the need for a method of correcting material or operating faults promptly, boiler malfunctions and abnormal fuel consumption may continue for weeks under ordinary trouble-shooting methods.

The "brain" of the system is a centrally located electronic coordinating unit. A special "scanning" device makes it possible for the system to gather data from widespread points of a boiler. Each scanning unit collects information from 25 different sensing elements. Any number of these devices may be hooked up with the system, depending on the quantity and location of points from which information is desired. Babcock & Wilcox Co.

Circle E11 green card, last page

Suit Protects Fire Fighters—A new fire protective, aluminized asbestos cloth which reflects radiant heat has just been introduced.

Safety garments made of "Kamklad" make it possible for the wearer to withstand temperatures in excess of 2500 F. without discomfort or ill-effect. They cut down injuries, save hours of labor because of the drastic reduction of heat fatigue and enable wearers to do jobs in emergencies that would be otherwise impossible.

A utility company tested the safety garment by having a man walk through a 2500 F. propane fire in order to extinguish it. The test was successful and he accomplished the job without difficulty.

"Kamklad" is a tightly woven asbestos cloth surfaced by a special process with a heat protective aluminum foil. The smooth aluminum foil surface reflects over 90 percent of all radiant heat with which it comes in contact thus shielding the wearer from this major hazard. Flying sparks and cinders fall right off without damaging the material. It resists water, oils, and, to all practical purposes, has the same corrosion-resistant qualities as the aluminum with which it is covered.

In addition to its use in protective garments "Kamklad" has many other applications such as fire baffles in industrial plants, and garages. It can also be used as fire protective curtains in welding booths, refractories, kilns and in other similar high temperature areas where protection from heat is necessary. Keasbey & Mattison Co.

Circle E12 green card, last page

New Maintenance Paint Booklet—Chlorinated natural rubber is known to be one of the most practical film-forming materials which is unaffected by acids, alkalies, salts moisture, and fungus growth. Both as a concrete and metal finish, Parlon-based paints are especially fitted for use under conditions too severe for regular paints and enamels, making them ideal finishes for use in many types of maintenance painting.

Paints with chlorinated natural rubber

FREE TEST CAN SAMPLE

shows how C-5 solves "HIGH-TEMP" THREAD PROBLEMS!

Prove it to your own satisfaction that C-5 ENDS STUD SEIZING AND GALLING EVEN AT 1800° F

Leading petroleum processors are now using C-5 for flange bolts, studs, and all other threaded surfaces on reactors, cat crackers, autoclaves, heating exchangers, catalytic reformers, pumps and valves, etc., and other applications where temperatures are up to 1800° F.

Fel-Pro's exclusive C-5 colloidal copper formula "copper-plates" metal . . . gives maximum cushioning and protection to 1800° F. without breakdown.

C-5 prevents galvanic action—eliminates pitting even where dissimilar metals are joined . . . protects all threaded surfaces, insuring their repeated re-use!

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"HIGH-TEMP"

√ Prevents Stud Breakage
√ Ends Stainless "Pitting"
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ANTI-SEIZE THREAD COMPOUND

INDUSTRIAL WASTE TREATMENT

Your waste treatment problems can be effectively solved by the skillful recovery of useful products and the re-use of treated water.

Talk it over with our nearest representative . . . he has the COMPLETE LINE of equipment and processes to best serve your needs.

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ÆSOP'S FABLES No. 5

The Tortoise finally became so annoyed at the jeers of the Hare about the slowness of his pace that he challenged Mr. Hare to a foot race. "Why, I can run circles around you!" said the Hare.

"No more of your boasting," said the Tortoise . . . "Be on with the race!"

Mr. Fox prescribed the course and started them off. Before you could blink your eyes twice the Hare was out of sight . . . while the Tortoise just plodded along. At the halfway point the Hare drew up and decided to take a rest and wait. He soon fell fast asleep . . . and the Tortoise went right by him . . . and on to *win the race!*

Moral:
"*Slow but sure*" *often meets with success.*

. . . but, "fast and sure" is the successful combination when you Gunite* your stud tube water walls with SUPER ADACHROME-CAST . . . Fine-grained to penetrate the small apertures between studs . . . packs to a dense mass when shot. In fact, one user reports SUPER ADACHROME-CAST lasted twice as long and took but one-third the time to apply as compared with a plastic chrome installation. Too, SUPER ADACHROME-CAST is excellent for coating brickwork when free of slag.

Write for detailed literature . . . Yellow Pages of 'phone directory have your nearest "ADAMANT" Distributor.

(*Tradename "Gunite" courtesy Cement Gun Co., Allentown, Pa.)

Botfield

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REFRACTORIES

ADAMANT and other ADA products

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philadelphia 47, penna.

For more data on advertised products, use Readers' Service Cards, last page.

New Equipment . . .

can be formulated to offer stubborn resistance to oxidizing agents, bleaches, cleaning compounds, and vapors and fumes. As a finish on cement, Parlon coatings resist the attack of alkalies within the concrete and at the same time withstand corrosive agents attacking the surface. Used on metal, this type of paint gives excellent protection because of its impermeability and resistance to corrosive attacks from acid and alkali solutions and fumes. Hercules Powder Company.

Circle E13 green card, last page

Welding Neck Flange—The recently introduced 125-pound taper face light weight welding neck flange offers important technical and cost advantages where the lighter schedule of pipe must be connected to 125-pound cast iron valves and other equipment.

The flange, overcomes two difficulties. First, its tapered face causes greater pressure to be exerted near the bore. This eliminates the usual problems met in obtaining a leakproof seal when a conventional flange with a full face gasket is used. Second, strain gage tests have shown that the new flange, equipped with a full face gasket, can be safely bolted to cast iron or semi-steel flanges. That is, it will not overstress or crack them, nor the integrally cast valves, pumps and other facilities they may serve. Also, hydrostatic tests indicate that when the new flange is properly employed the joint is capable of withstanding approximately three times the pressure it could contain if the taper was omitted.

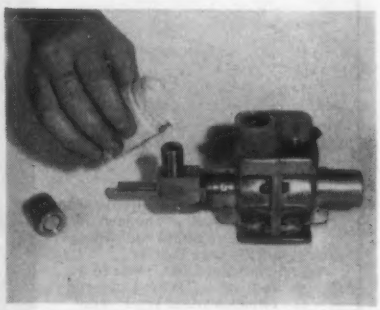
The new flange is rated at 125-pound for water, oil and gas service. It matches 125-pound cast iron flanges and valves made to ASA B16.1, and the bolt circle and drilling are the same as employed for ASA 150-pound standard steel flanges.

When 150-pound standard steel welding neck flanges are used with light weight, low pressure pipe they must be tapered bored, or specially bored, since the Code for Pressure Piping calls for a maximum mismatch of $\frac{3}{32}$ inch. This involves additional machining charges. The new flange, on the other hand, is made to match light weight pipe, and of course no such extra expense is entailed.

The new design does away with the common practice of using more costly and higher pressure class valves and flanges in order to obtain an adequate seal. Tube Turns. **Circle E14 green card, last page**

Water Filters—This 12-page, fully illustrated bulletin (WC-107A) completely describes the uses, design features and engineering details of pressure, sand and gravel filters.

Details of all accessory equipment, the different types of controls available and a detailed table giving capacities, sizes and space requirements are included. Cutaway views of both horizontal and vertical filters are shown as well as details of strainers, distributor systems and piping arrangements. Graver Water Conditioning Company. **Circle E15 green card, last page**



Pump Uses Fluid Teflon In Stuffing Box—A new fluid Teflon shaft seal on corrosion-resistant rotary, positive displacement pumps is now available for use with corrosive or high solvency liquids. The seal is arranged as an annular chamber around the pump shaft, in which two Teflon seal-ring retainers hold a fluid mass

Loosens FROZEN PARTS FAST!

Handy
Won't Leak
Shoots 3 Feet

Same formula as famous Kroil that has pleased 14,000 industrial users for 10 years or more.

Loosens stuck together metal parts, bushings, bearings, bolts, screws, pipe, etc., "anything from an embalmer's needle to a bulldozer," one customer said.

"Like an extra employee," said another. "Turned rust into mush, put $50,000 equipment back to work."

You too can get these results.

Try Aerokroil at our risk. Send $2 cash, and we'll pay postage.

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12-OZ. CAN $2.
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CASE OF 12 $18.75

How Metallizing saves money in refineries

cuts machine repair costs 80%—
cuts equipment "down-time"—
permits reduced spare parts stocks

Practically any worn machine part—repaired for only 15 or 20% of replacement cost—in minutes and hours, instead of days or weeks.

Pump shafts • Impeller journals • Motor shafts
Rotor blades • Packing areas • Pump plungers

The list of metallizing users in the Petroleum field reads like a Blue Book of the industry. Here are just a few:

Cities Service Refining Co.
Esso Standard Oil Co.
Gulf Oil Co.
Ohio Oil Co.
Phillips Petroleum Co.
Socony-Vacuum Oil Co.
Imperial Oil Co. (Canada)

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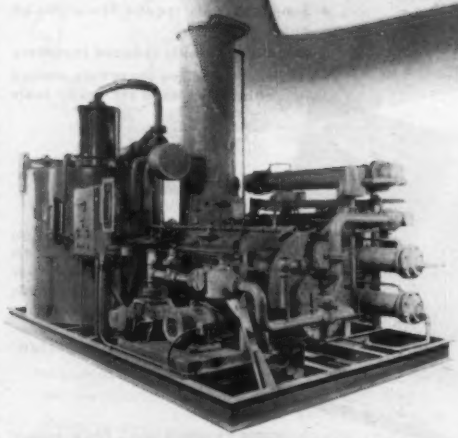

One of four 12,000 SCFH Nitrogen Generating Systems recently designed and installed at Ford Motor Company's Aircraft Engine Division by Gas Atmospheres.

THERE can be no doubt that the nation's largest corporations are staffed with specialists who know their business. Men of proved ability to make intelligent decisions. Perhaps that's why *Fortune's* new directory held so much interest for us—for we recognized nine of the first ten leading industrial corporations as Gas Atmospheres customers. In fact, the booklet was fairly studded with names of concerns who are using Gas Atmosphere's Gas Generating Systems for processing foods, petroleum, chemicals, metals, etc.

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of Teflon. A screw-in piston provides positive pressure on the fluid Teflon, making a practical "no-clearance fit" which effectively eliminates the passage of gases or fluids into or out of the pump. The lubricating qualities of Teflon minimize friction and prevent shaft scoring. The chemical inertness of Teflon makes the seal resistant to the corrosive or solvent action of virtually all chemical agents.

This seal has been tested for protracted periods on various pumps against heads up to 100 psi and vacuums to 28 inches, propelling such corrosive or difficult to handle liquids as carbon tetrachloride, high temperature dilute sulfuric acid and hot lubricating oils. Eco Engineering Co.

Circle E16 green card, last page

New Tower Tray Design—Use of a new tool in the process industries has enabled one crude oil unit to operate above 150 percent of its original design.

Ripple trays, the product of many years of experimentation, are simple perforated trays with sinusoidal type waves pressed into them and are used in vapor-liquid contacting operations, but promise much more general application where two phases are intermixed in countercurrent flow.

Outstanding advantages of the trays, which in some instances are superior to bubble cap trays, are high capacity, low cost, operating flexibility at high loads, and a special self-cleaning feature, it was reported.

Preliminary operating data have shown no indication of towers limiting with a crude rate of 31,500 b/d, a temporary maximum set by auxiliaries. The original design capacity with bubble cap trays had been 20,000 b/d, a rate beyond which fractionation began to suffer. Fractionation in general has been reported as comparable to the best obtained with the bubble cap installations when operated at their respective optimum loadings.

Ripple trays are now operating or soon will be operating in such fields as naphthalene and phenol purification, gasoline stabilization, tar separation, styrene rerunning, atmospheric and vacuum crude fractionation, demethanizing, deethanizing, debutanizing, ethylene-ethane splitting, propylene and isopentane recovery, raw ethylene quenching, acetone recovery, sulphur dioxide absorption in carbonate solution, ether-ethanol and ethanol-water fractionation, caustic scrubbing of raw ether, ether finishing, menthanol-formaldehyde fractionation and pine oil superfractionation. Stone & Webster Engineering Corp.

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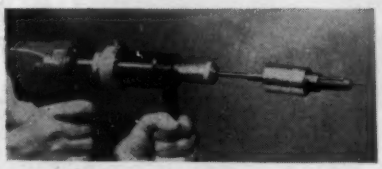

Tube Expanding Control—This development brings a new concept of torque control into tube expanding. Its operation is based on a powerful permanent magnet that gives positive and instantaneous engagement and disengagement between driving mechanism and the driven expander. The control is air-driven and therefore ideal for rolling tubes in hazardous locations. It is a single compact unit (weight 10 pounds, length 10½ inches) and is well balanced for ease in handling.

The control features a sensitive, easily adjusted calibrating dial that permits exact settings for torque control. There are no springs; therefore results are absolutely consistent. It has a positive drive action that stops instantaneously when pre-set torque is reached. Then, after disengagement of expander, the motor runs free, cutting the number of required stops and starts in half and also the control has an on-off locking switch and separate reversing trigger permitting uninterrupted sequence of operation. It has a quick-release chuck that locks expander securely, yet allows snap motion insertion or removal.

The control comes in a fitted metal case that holds both the control unit and expanders. It operates on 28 to 30 cfm of air at 90 psig. A single ⅜-inch air hose is the only connection required. Elliott Company.

Circle E18 green card, last page

New Chart for Brass Alloys—A comprehensive wall chart, 17 x 22 inches, describing brass, bronze and nickel silver casting alloys, is now available.

For quick reference by engineers and designers who specify the use of these alloys, the wall chart details information regarding 37 standard alloys, their Navy, S.A.E., ASTM and Federal specification designations, and the chemical composition by percentages of ingredient metals. Henning Bros. & Smith.

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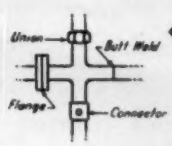

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Advertisers in This Issue

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*The asterisk preceding name of advertiser indicates that detailed data on products and services of the firm will be found in The 1956 Refinery Catalog.

* ADSCO Industries, Inc. 44
* Aerovent Fan Company
Large Propeller Division 346a
* The Air Preheater Corp. 325
* Airetool Manufacturing Co. 102
Allied Chemical & Dye Corp. 50, 234
* Allis-Chalmers Manufacturing Co. 27, 29
The Alpha Molykote Corp. 313
Amercoat Corp. 83
American Cyanamid Company
Refinery Chemicals Dept. 49
* American Recording Chart Co. 308
American Steel & Wire Division
United States Steel Corp. 252
Armco Steel Corp. 225
Armstrong Cork Co. 39
Armstrong Machine Works 95
The Atlantic Refining Co. 332-333
* Aurora Pump Division
The New York Air Brake Co. 330d

* B-I-F Industries, Inc. 2
* The Babcock & Wilcox Co. 223
* Badger Manufacturing Co. 88-89
Baker & Co. 265
* Baldwin-Hill Co. 338
* Barco Manufacturing Co. 100
Barrett Manufacturing Co. 337b
Bethlehem Steel Co. 84
W. H. & L. D. Betz 103
* Bigelow-Liptak Corp. 327
Bingham Pump Co. 64-65
Birlec Works 68Bb
Black Light Corp. of America 330a
* Black, Sivalls & Bryson, Inc. 281
Bonney Forge & Tool Co. 341
* Borg-Warner Corp. 93
* Bothield Refractories 349
* Bridgeport Brass Co. 82
The Bristol Co. 81
British Ermeto Corporation Ltd. 68D
Bucyrus-Erie Co. 62
* Buell Engineering Co. 104
* Buffalo-Eclipse Corp. 307
Burgess-Manning Co. 340b
* Byron Jackson Pumps, Inc.
Division Borg-Warner Corp. 93

* Calumet & Hecla, Inc. 231, 232
* Camco Products, Inc. 293
* The Cape Asbestos Company Ltd. 67
Carboline Co. 211
* G. O. Carlson, Inc. 80
Carter-Waters Corp. 337e
Catalytic Construction Co. 17
* Catawissa Valve & Fittings Co. 284
The Chapman Valve Mfg. Co. 79
Chicago Steel Tank Co.
Division U. S. Industries, Inc. 94
* Chicago-Wilcox Mfg. Co. 322c
* Chiksan Co. 47
Childers Manufacturing Co. 8
Clark Bros. Co. 55
Classified Advertising 334-337
Cleveland Wire Cloth & Mfg. Co. 206
Columbia-Geneva Steel Division
United States Steel Corp. 252
Conoflow Corp. 323
* The Cooper-Bessemer Corp. 273
* Crane Co. 205
* Crane Packing Co. 269
Crescent Insulated Wire & Cable Co. 340a
Crouse-Hinds Co. 77

Davison Chemical Company
Division W. R. Grace & Co. 87
De Laval Steam Turbine Co. 76
* Delta Engineering Sales Co. 276
Dicalite Division
Great Lakes Carbon Corp. 220
* Dollinger Corp. 229
* Dorr-Oliver, Inc. 282
Dowell Incorporated 209
* Dresser Industries, Inc. 55, 318
J. W. Droke & Associates 348b
* The Ducon Co. 230
E. I. du Pont de Nemours & Co. 110, 265, 266
* Durametallic Corp. 328a

* Eastern Industries, Inc. 270
Eastman Chemical Products, Inc. 292
* Elliott Co. 263
Enjay Company 297
* Ernst Water Column & Gage Co. 326b
Esso Research and Engineering Co. 51
The Fairbanks Co. 227
Felt Products Mfg. Co. 348a
J. C. Fennelly Co. 280
Fischer & Porter Co. 256
* Fisher Governor Co. 289
* Foster Wheeler Corp. 9
The Foxboro Co. 40-41
Frick Co. 322d
The Fyr-Fyter Co. 25

* The Garlock Packing Co. 11
Gas Atmospheres, Inc. 353
General Chemical Division
Allied Chemical & Dye Corp. 50
* General Electric Co. 13
General Metallizing & Machine Co. 326a
The Girdler Co. 43
* Fritz W. Glitsch & Sons, Inc. 117
The Globe Co. 228
Claud S. Gordon Co. 342
W. R. Grace & Co. 87
* Graham Manufacturing Co. 272
* Graver Tank & Mfg. Co. 6
Great Lakes Carbon Corp. 220
A. P. Green Fire Brick Co. 59
* Grinnell Co. 246
Gunite Concrete & Const. Co. 337f

H & M Pipe Beveling Machine Co. 298
* Hammond Iron Works 54
* Harbison-Walker Refractories Co. 277
The Harshaw Chemical Co. 315
* Haynes Stellite Company
Div. Union Carbide and Carbon Corp. 75
Head Wrightson & Co. Limited 68
Wyatt C. Hedrick Engineering Corp. 74
Hercules Powder Co. 317
* Hewitt-Robins, Inc. 216-217
Hooker Electrochemical Co. 319
Houdry Process Corp. 21
* Hudson Engineering Corp. 118

* Ingersoll-Rand Co. 22-23
Insul-Mastic Corp. of America 321
* International Engineering, Inc. 324
The International Nickel Co. 85
* Irving Subway Grating Co. 346

* Jerguson Gage & Valve Co. 267a
* Johns-Manville Corp. 224, 268
Jones, Tate & Co. Ltd. 68Aa
Jordan Corp.
Industrial Sales Div. OPW Corp. 107

Kano Laboratories 350a
* Keasbey & Mattison Co. 250
* The M. W. Kellogg Co. 112-113
Kinney Manufacturing Division
The New York Air Brake Co. 345
* Koch Engineering Co. 291
L. O. Koven & Bro. Inc. 70

Ladish Co. 299
* Lake & Elliot, Ltd. 68cb
Lapp Insulator Co. 30
Leeds & Northrup Co. 248
Lewin-Mathes Co. 90
Lidell Engineering Service 312
The Lincoln Electric Co. 316
* The Lummus Co. 71, 258

* The Mack Iron Works Co. 326c
* Magnetrol, Inc. 347b
Manning and Lewis Engineering Co. 306
* Clayton Mark & Co. 300
* Jas. P. Marsh Corp. 86
* Mason-Neilan
Division Worthington Corp. 52-53
Arthur G. McKee & Co. 242
* Metal Propellers, Limited 68Ba
* Metal Textile Corp. 72
Metallizing Engineering Co. 350b
* Metallo Gasket Co. 343a
Mexico Refractories Co. 271
Midcontinent Tube Service, Inc. 337c
Milton Roy Co. 309
Minneapolis-Honeywell Regulator Co. 73
Misco Fabricators, Inc. 286
* W. K. Mitchell & Co. 254
* Mixing Equipment Co. 108
* Moncrief-Lenoir Mfg. Co. 330c
Monsanto Chemical Co. 46
* Murray Iron Works Co. 314

* National Airoil Burner Co. 310a
National Aluminate Corp. 214
National Tube Division
United States Steel Corp. 60, 252
New England Tank & Tower Co. 299
New England Valve Corp. 240
* The New York Air Brake Co. 330d, 345
Newalls Insulation Co. 69
Niagara Blower Co. 302a
Nocon Products Corp. 322a
* W. C. Norris, Manufacturer, Inc. 219
* Norton Co. 12

OPW Corp. 107
* Oakite Products, Inc. 305
The Ohio Injector Co. 32
* Oil Well Supply Division
United States Steel Corp. 7
The Okonite Co. 91
* Orbit Valve Co. 42

Packed Column Corp. 326d
Palmer Thermometers, Inc. 267b
* Panellit, Inc. 303
Patton Manufacturing Co. 353
* Penberthy Manufacturing Co.
Division Buffalo-Eclipse Corp. 307
* The Permutit Co. 78
* Petreco Division
Petrolite Corp. 295
* Petro-Chem Development Co. 33
Petroleum Electric Power Assoc. 63
* The Pfaudler Co. 244-245
* Phelps Dodge Copper Products Corp. 14-15
* H. K. Porter Co. 288
* Potter Aeronautical Co. 57
Horace T. Potts Co. 352b
The Wm. Powell Co. 45
* Proportioneers, Inc. 2
Puget Sound Fabricators, Inc. 353b
Pyrene-C-O-Two Division
The Fyr-Fyter Co. 25

* The Refinery Catalog 96-97
The Refinery Engineering Co. 61
* Geo. P. Reintjes Co. 337b
The Ridge Tool Co. 353c
W. S. Rockwell Co. 310b
* Rockwell Manufacturing Co. 358
* Rockwood Sprinkler Co. 37, 311
Roots-Connersville Blower Div.
Dresser Industries, Inc. 318

* Sarco Co. 206
Schott Bros. Co. 322b
* Schuyler Manufacturing Corp. 238
* Scovill Manufacturing Co. 56
* Sealol Corp. 347a
Shand & Jurs Co. 329
* Shaw-Petrie Limited 66
Sheffield Division
Armco Steel Corp. 225
Sherman Products, Inc. 38
* M. B. Skinner Co. 330b
* S. Morgan Smith Co. 320
Solvay Process Division
Allied Chemical & Dye Corp. 234
Southern Engine & Pump Co. 352a
Speedline Stainless Steel Fittings Div.
Horace T. Potts Co. 352b
August Spinkler & Sons, Inc. 302b
Standard Oil Company of Calif. 298
* Sun Shipbuilding & Dry Dock Co. 24
Sunvic Controls Limited 68Ab

* Taylor Instrument Companies 236-237
Tennessee Coal & Iron Division
United States Steel Corp. 212-213, 252
* The Terry Steam Turbine Co. 48
* Texas Metal Fabricating Co. 226
Thermal Research & Engineering Corp. 296
Arthur Tickle Engineering Works 344b
The Timken Roller Bearing Co. 20
Titeflex, Inc. 210
Tracerlab, Inc. 343b
* Tretolite Co. 99
* Tube Turns, Inc. 35, 36

* Union Asbestos & Rubber Co. 98
* Union Carbide and Carbon Corp. 75
Union Wire Rope Corp. 221
* U. S. Hoffman Machinery Corp. 301
U. S. Industries, Inc. 94
United States Pipe & Foundry Co. 278-279
* United States Rubber Co. 31
United States Steel Corp. .. 7, 26, 60, 212-213, 252
United States Steel Export Co. 212-213, 252
* The United States Stoneware Co. 10
United States Steel Supply Division
United States Steel Corp. 212-213, 252
Universal Oil Products Co. 18-19

Visco Products Co. 203
* Henry Vogt Machine Co. 58
* J. H. H. Voss Co. 328b

* W-S Fittings Division
H. K. Porter Co. 288
The E. H. Wachs Co. 304a
Wagner Electric Corp. 34
* James Walker & Co. Ltd. 68Ca
Walworth Co. 92
Warren Petroleum Corp. 275
Watchmoket Optical Co. 331
West Instrument Corp. 283
Western Supply Co. 101
* The Gustav Wiedeke Co. 290
The Wilbur & Williams Co. 304b
A. R. Wilfley & Sons 287
T. D. Williamson, Inc. 222
* Thomas C. Wilson, Inc. 16
* Wolverine Tube Division
Calumet & Hecla, Inc. 52-53, 231, 232
* Worthington Corp. 52-53
Wyatt Metal & Boiler Works 357
* Yarnall-Waring Co. 28

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E1 E13	E2 E14	E3 E15	E4 E16	E5 E17	E6 E18	E7 E19	E8	E9	E10	E11	E12

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6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
66	67	68Aa	68Ab	68Ba	68Bb	68Ca	68Cb	68D	69	70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	107	108	110	112	113	117	118	203	205	206	208	209	210	211	212
213	214	216	217	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	236
237	238	240	242	244	245	246	248	250	252	254	256	258	263	265	266	267a	267b	268	269
270	272	273	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292
293	295	296	297	298	299	300	301	302a	303b	303	304a	304b	305	306	307	308	309	310a	310b
311	312	313	314	315	316	317	318	319	320	321	322a	322b	322c	322d	323	324	325	326a	326b
326c	326d	327	328a	328b	329	330a	330b	330c	330d	331	332	333	334	335	336	337a	337b	337c	337d
337e	339	340a	340b	341	342	343a	343b	344a	344b	345	346	347a	347b	348a	348b	349	350a	350b	351
352a	352b	353a	353b	353c	357	358													

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46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
66	67	68Aa	68Ab	68Ba	68Bb	68Ca	68Cb	68D	69	70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	107	108	110	112	113	117	118	203	205	206	208	209	210	211	212
213	214	216	217	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	236
237	238	240	242	244	245	246	248	250	252	254	256	258	263	265	266	267a	267b	268	269
270	272	273	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292
293	295	296	297	298	299	300	301	302a	303b	303	304a	304b	305	306	307	308	309	310a	310b
311	312	313	314	315	316	317	318	319	320	321	322a	322b	322c	322d	323	324	325	326a	326b
326c	326d	327	328a	328b	329	330a	330b	330c	330d	331	332	333	334	335	336	337a	337b	337c	337d
337e	339	340a	340b	341	342	343a	343b	344a	344b	345	346	347a	347b	348a	348b	349	350a	350b	351
352a	352b	353a	353b	353c	357	358													

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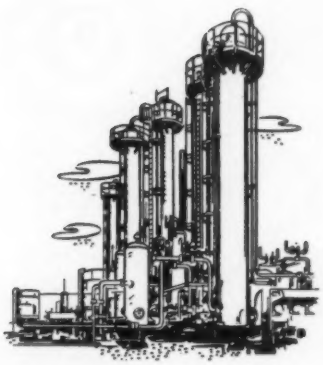
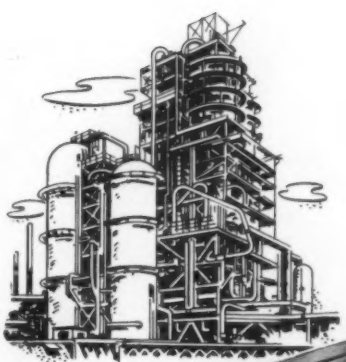


• This record rail load for length, 192 feet, was Fabricated in Wyatt's Houston Plant for Oil Refining Service on the Gulf Coast



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